



Unit 1

Periodicity of Elements and Their Properties



Lesson 1:

Attempts of elements classification.

Lesson 2:

Graduation of the properties of elements in the modern periodic table.

Lesson 3

The main groups in the modern periodic table.



Lesson 4

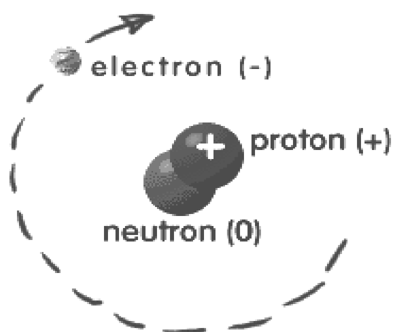
Water



Introduction

The atom is the smallest unit of an element which undergoes a chemical reaction without being changed.

1. The structure of the atom
   a. The nucleus contains positively charged **protons** & neutral particles called **neutrons.**
   b**. Electrons** are negatively charged particles which revolve around the nucleus in energy levels with high speed.
2. The **atomic number** is the number of protons in the nucleus .
3. The **mass number** is the number of protons + neutrons in the atom.
4. The number of protons = the number of electrons in a neutral atom.

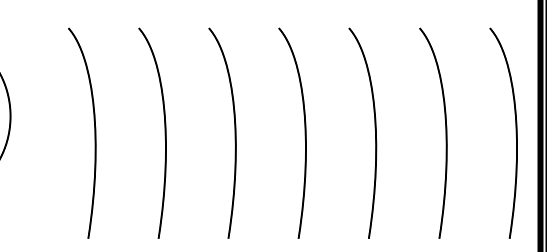


Energy levels

1. Electrons revolve around the nucleus in fixed orbits called energy levels.

2. The smallest atom (hydrogen) has one energy level

3.The biggest atom has 7 energy levels.



K L M N O P Q

The energy of the level increases

The energy of the level decreases

The electronic configuration

1. The rule $2n^2$ is used to find the number of electrons that fill each energy level. n is the number of the level.
2. The first energy level is filled with : $2(1)^2 = 2$ electrons.

3. The 2nd energy level is filled with : $2(2)^2 = 8$ electrons.

4. The 3rd energy level is filled with $2(3)^2 = 18$ electrons.

5. The 4th energy level is filled with $2(4)^2 = 32$ electrons.

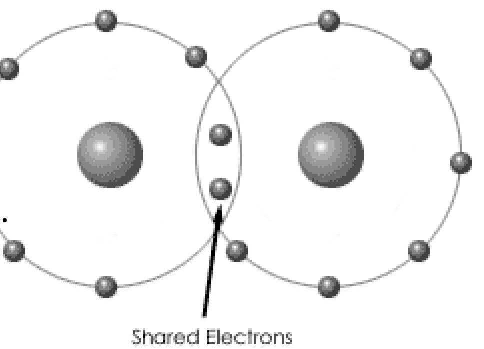
6. Levels 5-7 are filled with 32 electrons only . The rule $2n^2$ isn't applied because the level can only contain 32 electrons. The presence of more than 32 electrons in an energy level would make the atom unstable.

Valency: is the number of electrons gained or lost or shared by an atom in a chemical reaction.

The element	*The valency*		*The ion*
Sodium	1	mono	Na^{+}
calcium	2	di	Ca^{+2}
Aluminium	3	tri	Al^{+3}
Silicon	4	tetra	Si^{+4}
Sulphur	2	di	S^{-2}
Chlorine	1	mono	Cl^{-}
Neon	0	zero	_

What's meant by :

1. **Sodium is monovalent.**
   Sodium loses one electron in a chemical reaction.
2. **Oxygen is divalent.**
   Oxygen shares or gains 2 electrons in a chemical reaction.
3. **The valency of helium is zero.**
   Helium doesn't go into chemical reaction.



Using the electronic configuration to find the type of element

The type of the element	*The electronic configuration*	*Examples*
Metals	The outermost energy level has 1 or 2 or 3 electrons.	Sodium
Metalloids	The outermost energy level has 4 electrons.	Silicon
Non-metals	The outermost energy level has 5 or 6 or 7 electrons.	Chlorine
Inert (noble) gases	The outermost energy level has 8 electrons except helium which has 2 electrons only.	Argon

Give reasons for the following:

Although hydrogen has 1 electron in its outermost level , it's a non-metal.

- Because its properties resemble non-metals. It's a gas while metals are solids except mercury.
- A hydrogen molecule consists of 2 hydrogen atoms . Metal molecules consist of 1 atom only.

Lesson 1:

Attempts to classify elements



Scientists in 1871 had discovered 67 elements & knew their characteristics , but no one has arranged the elements according to their properties. Organizing the elements according to their characteristics is important to understand how they react together.

1-Medeleev's Periodic table :

- **Mendeleev was a Russian chemist who arranged elements in a table in order of increasing atomic weights.**
- He found that elements properties followed a pattern that repeated every 7 elements & therefore he arranged elements of similar properties in **vertical columns** known as **groups.** The horizontal rows in the table are known as **periods.**
- The **properties** of elements were **repeated** periodically by the beginning of each new period.

Advantages of Mendeleev's table :

1-He left **gaps** in his table for elements not found in his time & predicted the discovery of **new elements** & predicted their properties & their atomic weights**.**

2-He **corrected the atomic weights** of some elements which were estimated wrongly.

Some flaws in Mendeleev's periodic table:

Few elements' properties didn't fit the pattern in the table, therefore their order was reversed because their properties dictated their groups. Mendeleev thought that more accurate measurements of the atomic weights will fix these flaws.

Series	Group I	Group II	Group III	Group IV	Group V	Group VI	Group VII	Group VIII
1	H=1							
2	Li=7	Be=9.1	B=11	C=12	N=14	O=16	F=19	
3	Na=23	Mg=24.4	Al=27	Si=28	P=31	S=32	Cl=35.5	Fe=56, Ni=58.5, Co 59.1, Cu 63.3.
4	K=39.1	Ca=40	— =44	Ti=48.1	V=51.2	Cr=52.3	Mn=55	
5	(Cu)=63.3	Zn=65.4	— =68	— =72	As=75	Se=79	Br=80	Rh=103, Ru=103.8, Pd=108, Ag=107.9.
6	Rb=85.4	Sr=87.5	Y=89	Zr=90.7	Nb=94.2	Mo=95.9	— =100	
7	(Ag)=107.9	Cd=112	In=113.7	Sn=118	Sb=120.3	Te=125.2	I=126.9	— — —
8	Cs=132.9	Ba=137	La=138.5	Ce=141.5	Di=145	—	—	
9	(—)	—	—	—	—	—	—	Ir=193.1, Pt=194.8, Os=200, Au=196.7.
10	—	—	Yb=173.2	—	Ta=182.8	W=184	—	
11	(Au)=196.7	Hg=200.4	Tl=204.1	Pb=206.9	Bi=208	—	—	— — —
12	—	—	—	Tb=233.4	—	U=239	—	

Mendeleev's periodic table

2. The periodic law:

a. The scientist **Rutherford** discovered that the nucleus of the atom contains **positively charged protons.**

b. Later the British scientist **Mosley** determined the number of protons in an atom (The **atomic number**). All the elements in Mendeleev's table fit the pattern if they were arranged in order of increasing atomic number.

The periodic law states that the repeating chemical & physical properties of elements change periodically with the elements' atomic number

3- The modern periodic table

- 116 elements are classified in the modern periodic table , 92 elements are found naturally, while the rest are prepared artificially.
- Scientists discovered that electrons are found in **energy levels** around the nucleus**.** The heaviest atom contains 7 energy levels.
- Each main level contains regions where electrons can exist according to their energy, these were called energy **sublevels .**

- Elements were classified in the **modern periodic table according to their ascending atomic numbers & according to the filling of energy sublevels with electrons.**
- Each horizontal row of elements is called a period. There're 7 periods in the periodic table. The physical & chemical properties of elements in a period change gradually from left to right.
- Each vertical column of elements is called a group. There're **18 columns** in the periodic table. Elements in a group have similar properties.

❖ **The elements of modern periodic table are classified into 4 blocks (s,p,d and f)**

s-block elements

-They are found on the **left side** of the periodic table.

-They are 2 groups **(1A)** and **(2A).**

d-block elements

-They are found in the **middle** of the periodic table.
-They are arranged in 8 **groups (3B),(4B),(5B),(6B),(7B),(8),(1B) and (2B).**
-They are known as **transitional elements**
-They start appearing in **period (4)**

p-block elements

-They are found on the **right side** of the periodic table.
-They are 6 groups **(3A),(4A),(5A),(6A) (7A)** and **zero**

f-block elements
-are located **below** the periodic table
-include **lanthanides** and **actinides**

4-To find the position of an element in the periodic table, follow these Steps:

1. Use the atomic number to find the electronic configuration.
2. The number of energy levels filled by electrons = the number of the period.
3. The number of electrons in the last energy level = the number of the group .

Example:

Sodium 11Na electronic configuration is : 2,8,1

1 electron = 1st group

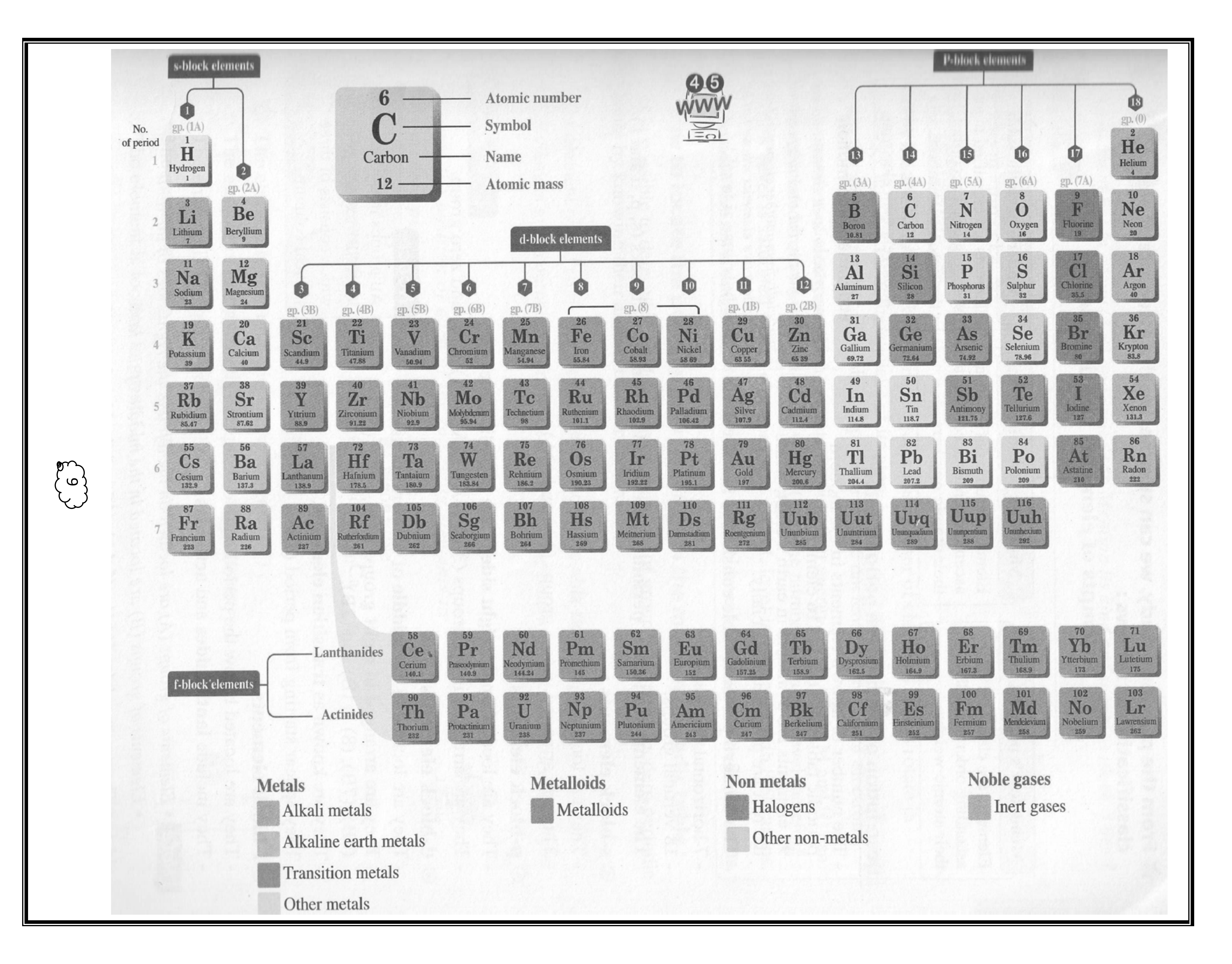
3 energy levels = 3rd period



5-The following table explains how electronic configuration is used to Locate the position of some elements in the modern periodic table :

Name of element	Symbol	electronic configuration	No. of energy levels	The number of the period	No. of electrons in the last energy level	The number of the group
Hydrogen	$_{1}H$	1	1	1	1	1
Neon	$_{10}Ne$	2,8	2	2	8	0
Phosphorous	$_{15}P$	2,8,5	3	3	5	5
Calcium	$_{20}Ca$	2,8,8,2	4	4	2	2





s-block elements
p-block elements
d-block elements
f-block elements
No. of period
6 C Carbon 12
Atomic number
Symbol
Name
Atomic mass
gp. (1A)
gp. (2A)
gp. (3B)
gp. (4B)
gp. (5B)
gp. (6B)
gp. (7B)
gp. (8)
gp. (1B)
gp. (2B)
gp. (3A)
gp. (4A)
gp. (5A)
gp. (6A)
gp. (7A)
gp. (0)
1 H Hydrogen 1
2 He Helium 4
3 Li Lithium 7
4 Be Beryllium 9
5 B Boron 10.81
6 C Carbon 12
7 N Nitrogen 14
8 O Oxygen 16
9 F Fluorine 19
10 Ne Neon 20
11 Na Sodium 23
12 Mg Magnesium 24
13 Al Aluminum 27
14 Si Silicon 28
15 P Phosphorus 31
16 S Sulphur 32
17 Cl Chlorine 35.5
18 Ar Argon 40
19 K Potassium 39
20 Ca Calcium 40
21 Sc Scandium 44.9
22 Ti Titanium 47.88
23 V Vanadium 50.94
24 Cr Chromium 52
25 Mn Manganese 54.94
26 Fe Iron 55.84
27 Co Cobalt 58.93
28 Ni Nickel 58.69
29 Cu Copper 63.55
30 Zn Zinc 65.39
31 Ga Gallium 69.72
32 Ge Germanium 72.64
33 As Arsenic 74.92
34 Se Selenium 78.96
35 Br Bromine 80
36 Kr Krypton 83.8
37 Rb Rubidium 85.47
38 Sr Strontium 87.62
39 Y Yttrium 88.9
40 Zr Zirconium 91.22
41 Nb Niobium 92.9
42 Mo Molybdenum 95.94
43 Tc Technetium 98
44 Ru Ruthenium 101.1
45 Rh Rhaodium 102.9
46 Pd Palladium 106.42
47 Ag Silver 107.9
48 Cd Cadmium 112.4
49 In Indium 114.8
50 Sn Tin 118.7
51 Sb Antimony 121.75
52 Te Tellurium 127.6
53 I Iodine 127
54 Xe Xenon 131.3
55 Cs Cesium 132.9
56 Ba Barium 137.3
57 La Lanthanum 138.9
72 Hf Hafnium 178.5
73 Ta Tantaium 180.9
74 W Tungesten 183.84
75 Re Rehnium 186.2
76 Os Osmium 190.23
77 Ir Iridium 192.22
78 Pt Platinum 195.1
79 Au Gold 197
80 Hg Mercury 200.6
81 Tl Thallium 204.4
82 Pb Lead 207.2
83 Bi Bismuth 209
84 Po Polonium 209
85 At Astatine 210
86 Rn Radon 222
87 Fr Francium 223
88 Ra Radium 226
89 Ac Actinium 227
104 Rf Rutherfordium 261
105 Db Dubnium 262
106 Sg Seaborgium 266
107 Bh Bohrium 264
108 Hs Hassium 269
109 Mt Meitnerium 268
110 Ds Darmstadtium 281
111 Rg Roentgenium 272
112 Uub Ununbium 285
113 Uut Ununtrium 284
114 Uuq Ununquadium 289
115 Uup Ununpentium 288
116 Uuh Ununhexium 292
Lanthanides
Actinides
58 Ce Cerium 140.1
59 Pr Praseodymium 140.9
60 Nd Neodymium 144.24
61 Pm Promethium 145
62 Sm Samarium 150.36
63 Eu Europium 152
64 Gd Gadolinium 157.25
65 Tb Terbium 158.9
66 Dy Dysprosium 162.5
67 Ho Holmium 164.9
68 Er Erbium 167.3
69 Tm Thulium 168.9
70 Yb Ytterbium 173
71 Lu Lutetium 175
90 Th Thorium 232
91 Pa Protactinium 231
92 U Uranium 238
93 Np Neptunium 237
94 Pu Plutonium 244
95 Am Americium 243
96 Cm Curium 247
97 Bk Berkelium 247
98 Cf Californium 251
99 Es Einsteinium 252
100 Fm Fermium 257
101 Md Mendelevium 258
102 No Nobelium 259
103 Lr Lawrensium 262
Metals
Alkali metals
Alkaline earth metals
Transition metals
Other metals
Metalloids
Metalloids
Non metals
Halogens
Other non-metals
Noble gases
Inert gases

Graduation of the properties of elements in the Modern Periodic Table.

The **Atomic size , electronegativity , metallic and non-metallic properties** show graduation in periods and groups in the periodic table.

1-Atomic size

The **atomic radius** is a measure of the **atomic size of the atom**.

Its unit is **picometer (p)**.

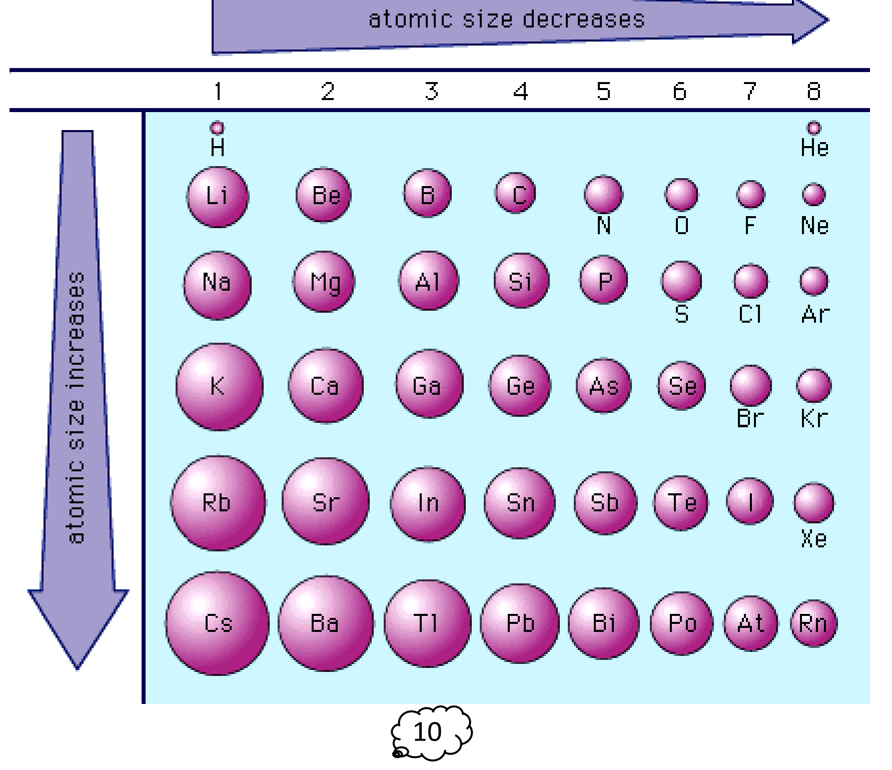
(The picometer = part from million million parts of a meter 1 p = 10^{-12} m)

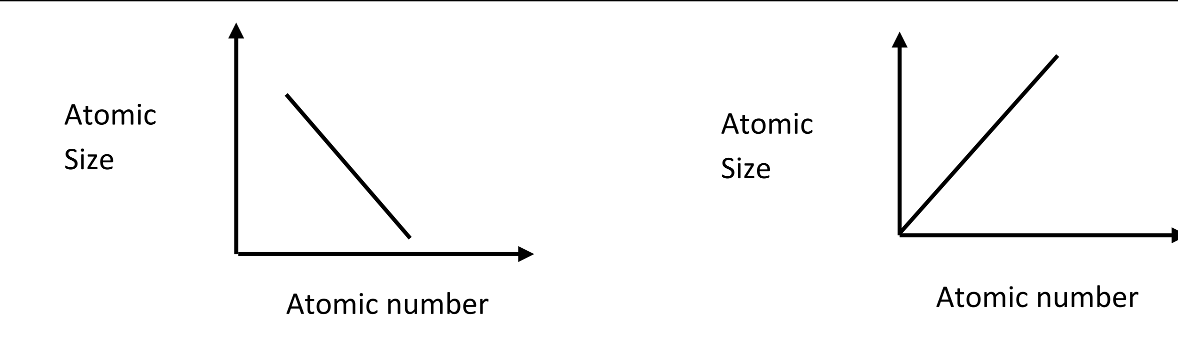
I. Graduation of the atomic size of elements in the periodic table :

1-All the elements in a certain period have the same number of energy levels , therefore as We move **from left to right, the** attraction force between the positive nucleus and the outermost level electrons increases ➔ **the atomic size decreases** from left to right in a certain period.

2-In a certain group , the number of energy levels increases **moving downwards** , therefore the **atomic size increases** downwards in the same group.

The following figure represents the atomic size variation of some elements in the periodic Table.





The atomic size is inversely proportional to the atomic number in a period.

The atomic size is directly proportional to the atomic number in the group.

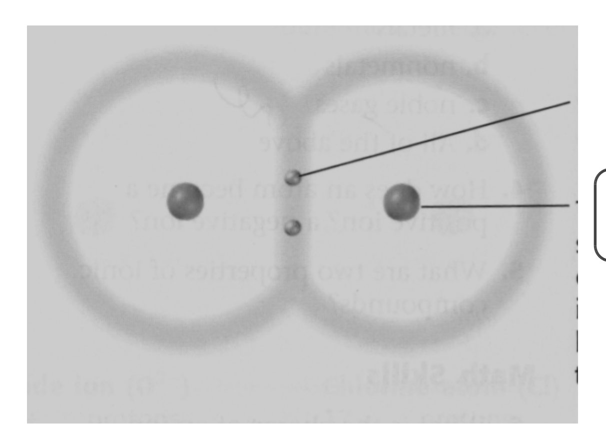
Atomic Radii (pm)

1A	2A	3A	4A	5A	6A	7A	8A
						37	31
Li 152	Be 112	B 85	C 77	N 75	O 73	F 72	Ne 71
Na 186	Mg 160	Al 143	Si 118	P 110	S 103	Cl 100	Ar 98
K 227	Ca 197	Ga 135	Ge 122	As 120	Se 119	Br 114	Kr 112
Rb 248	Sr 215	In 167	Sn 140	Sb 140	Te 142	I 133	Xe 131
Cs 265	Ba 222	Tl 170	Pb 146	Bi 150	Po 168	At (140)	Rn (141)

2- Electronegativity

The covalent bond is formed between 2 atoms that share a pair of electrons or more.

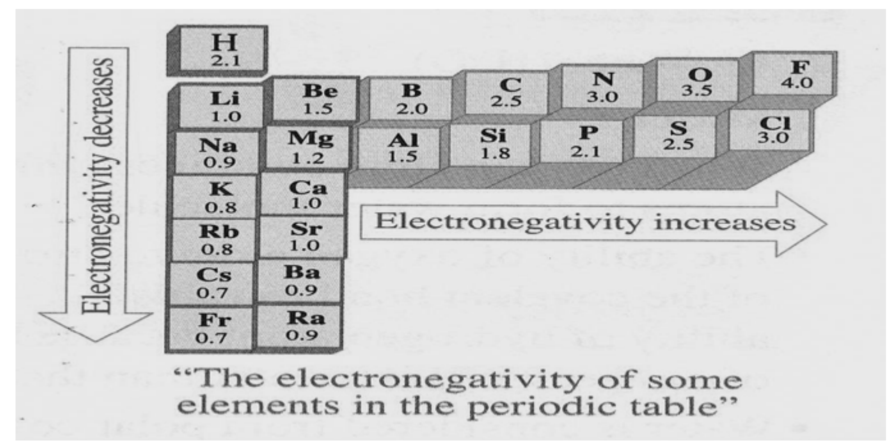
Electronegativity is the ability of an atom bonded by a covalent bond to attract the shared electrons towards it.



2 Hydrogen atoms share a pair of electrons.

II-Graduation of electronegativity of elements in the periodic table :

The following figure is a part of the periodic table to show the graduation of the electronegativity of some elements:

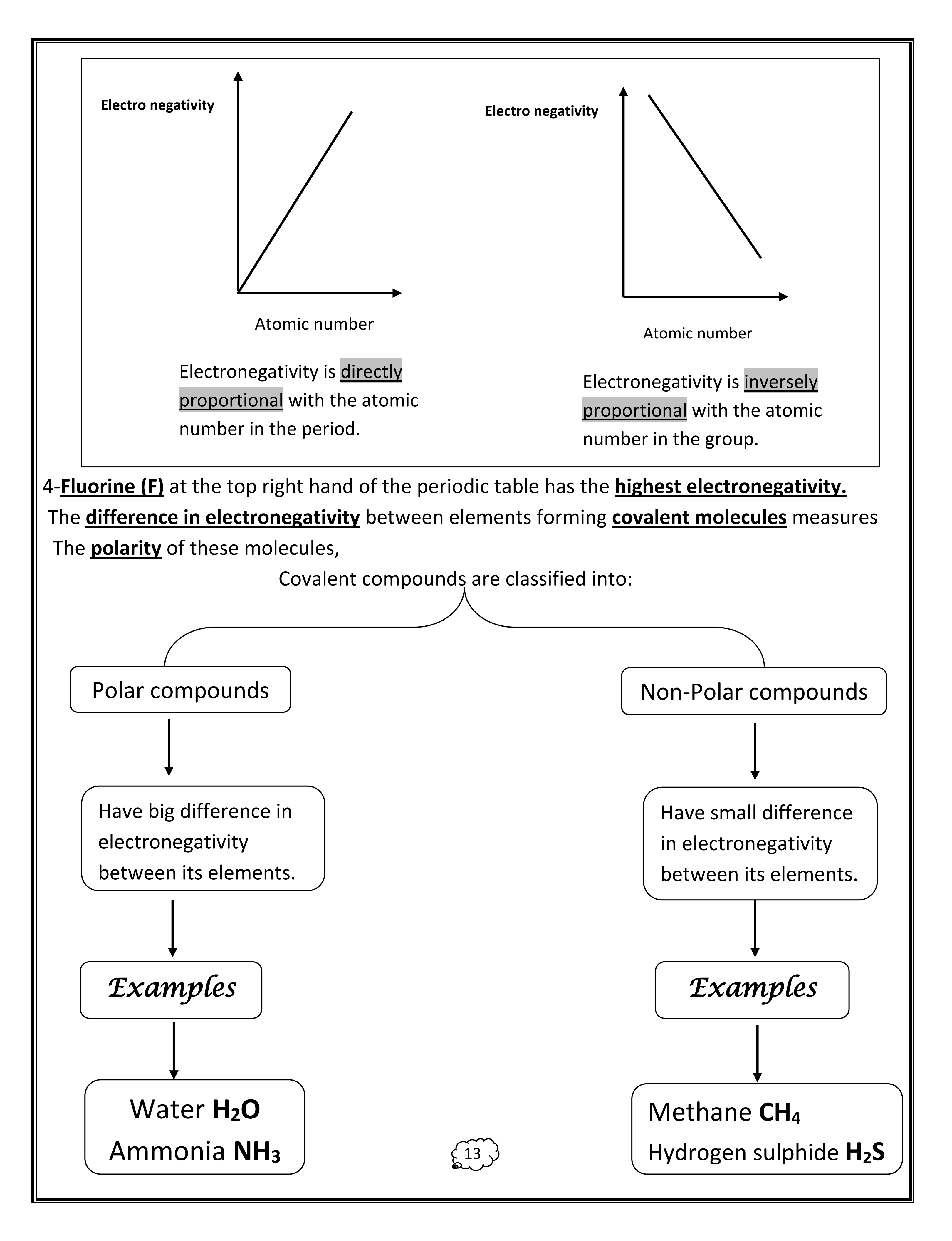


"The electronegativity of some elements in the periodic table"

1-Moving from **left to right** in the same period , the atomic size decreases & therefore **The electronegativity increases** .

2-Moving **downwards** in the same group, the atomic size increases & the **electronegativity decreases**

3-There's an inverse relation between the atomic size of an element & the **electronegativity.**



Electronegativity is directly proportional with the atomic number in the period.

Electronegativity is inversely proportional with the atomic number in the group.

4-**Fluorine (F)** at the top right hand of the periodic table has the **highest electronegativity.**

The **difference in electronegativity** between elements forming **covalent molecules** measures The **polarity** of these molecules,

Covalent compounds are classified into:

Polar compounds

Have big difference in electronegativity between its elements.

Examples

Water H_2O

Ammonia NH_3

Non-Polar compounds

Have small difference in electronegativity between its elements.

Examples

Methane CH_4

Hydrogen sulphide H_2S

Polar compounds:

- In a **water** molecule **H_2O**. The oxygen atom attracts the shared electrons towards it because its electronegativity (3.5) is higher than that of hydrogen (2.1).

- Therefore water is a **polar compound**

- In an **Ammonia** molecule **NH_3** ,Nitrogen attracts the shared electrons strongly because its electro negativity (3) is higher than hydrogen (2.1) , therefore , **ammonia is a polar compound .**

Non- polar compounds:

- Methane (**CH_4**) and hydrogen sulphide (**H_2S**) aren't polar compounds because the difference in electronegativity between their elements is small (0.4)

The difference in electronegativity between elements forming compounds determines the type of bond in a compound (whether ionic or covalent)

The difference in electronegativity between the elements within a compound	The type of compound (ionic or covalent)
0→ 0.4	Non-polar
0.5→ 1.7	Polar covalent
≥1.8	Ionic

Solved examples:

Example 1:

Conclude the difference in electro negativity in the following compounds :

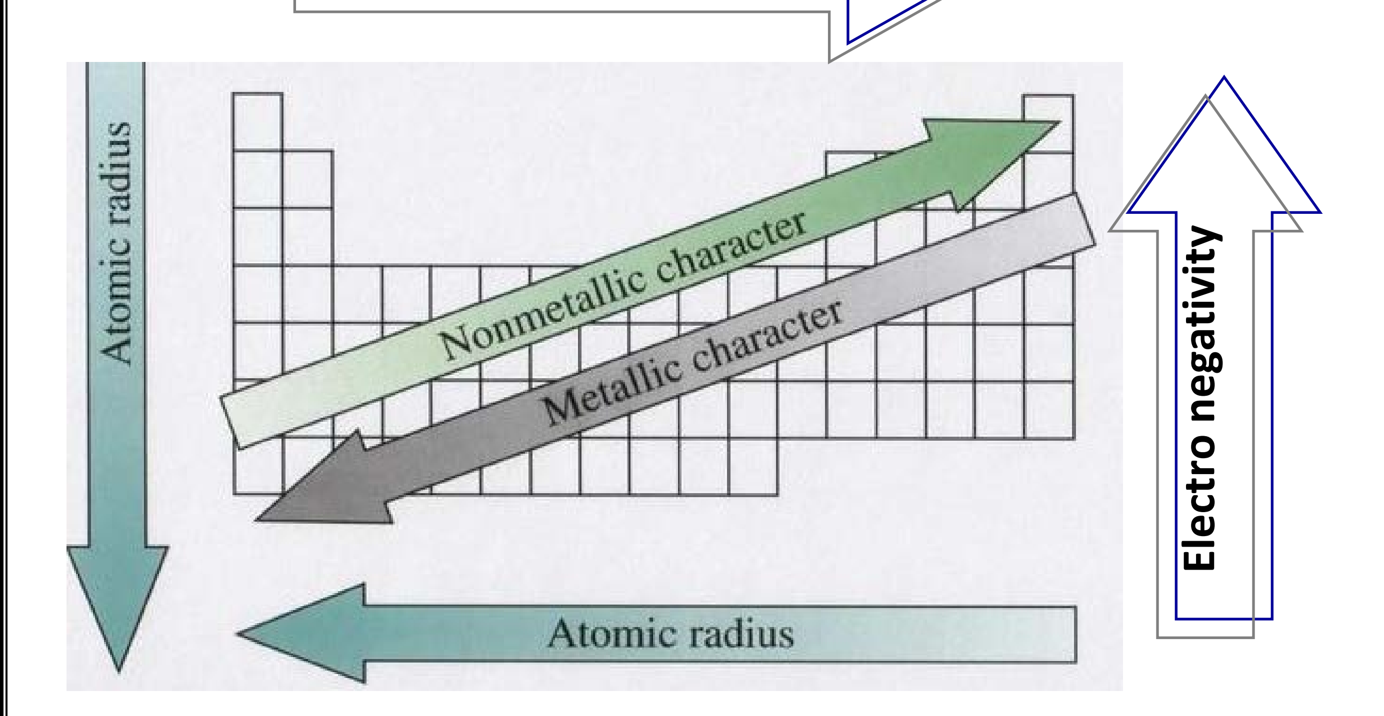
a) HCl b) NaCl c) CO_2

The electro negativity of the elements are as follows :

H = 2.1 Na =0.9 Cl = 3 C =2.5 O=3.5

Solution:

The compound	The difference in electro negativity
HCl	3-2.1 = 0.9
NaCl	3- 0.9 = 2.1
CO_2	3.5 -2.5 = 1



3-Metallic and non-metallic property

According to their properties, elements in the periodic table are classified into:

- 1-Metals
- 2-Non-metals
- 3-Metalloids (semimetals)
- 4-Noble gases

1-Metals

- They have **less than four electrons** in their outermost energy levels.
- In a chemical reaction, they **lose** their outermost electrons and form **positive ions**.
- The number of positive charges on their ions = the number of lost electrons.
- The electronic structure of the positive ion is similar to that of the nearest preceding inert gas in the periodic table.

Examples:

1. Sodium atom ($_{11}Na$) 2, 8, 1 → Loses 1 electron → **Na^+ (sodium ion)** 2, 8 **(Similar to $_{10}Ne$)**

2-Magnesium ($_{12}Mg$) 2, 8, 2 → Loses 2electrons → **Mg^{+2} (Magnesium ion)** 2,8 **(Similar to $_{10}Ne$)**

3-Aluminium ($_{13}Al$) 2, 8, 3 → Loses 3electrons → **Al^{+3} (Aluminum ion) 2,8** **(Similar to $_{10}Ne$)**

Monovalent ions	Symbol	Divalent ions	Symbol	Trivalent ions	Symbol
Sodium	Na^{+}	Magnesium	Mg^{2+}	Aluminum	Al^{3+}
Potassium	K^{+}	Calcium	Ca^{2+}	Iron III	Fe^{3+}
		Copper II	Cu^{2+}		
		Iron II	Fe^{2+}		



<u>Graduation of metallic and non-metallic property in the modern periodic table :</u>

- **The period** starts with **<u>a strong metal</u>** in group **<u>(1A)</u>** and the **<u>metallic property gradually decreases</u>** by **<u>increasing the atomic number .</u>** These elements are followed by **<u>metalloids.</u>**
- The **<u>non-metallic property</u>** appears and increases by **<u>increasing the atomic number</u>**. The strongest non-metals are found in group (7A) followed by group zero (inert gases).
- By increasing the atomic number within the same group, the metallic property increases & the non-metallic decreases.
- The metallic property is related to the atomic size. Both increase or decrease together.

Example:

The graduation of metallic and non-metallic property within period "3"

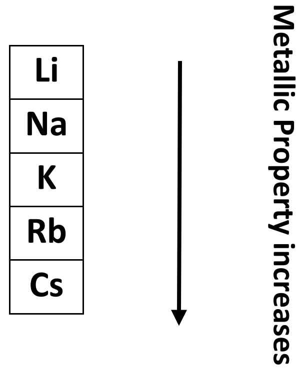
Metallic property decreases →

Period 3	$_{11}Na$ Sodium	$_{12}Mg$ Magnesium	$_{13}Al$ Aluminium	$_{14}Si$ Silicon	$_{15}P$ Phosphorous	$_{16}S$ Sulphur	$_{17}Cl$ Chlorine	$_{18}Ar$ Argon
Electronic configuration	2,8,1	2,8,2	2,8,3	2,8,4	2,8,5	2,8,6	2,8,7	2,8,8
Kind of element	Metal	Metal	Metal	Metalloid	Non-metal	Non-metal	Non-metal	Inert gas

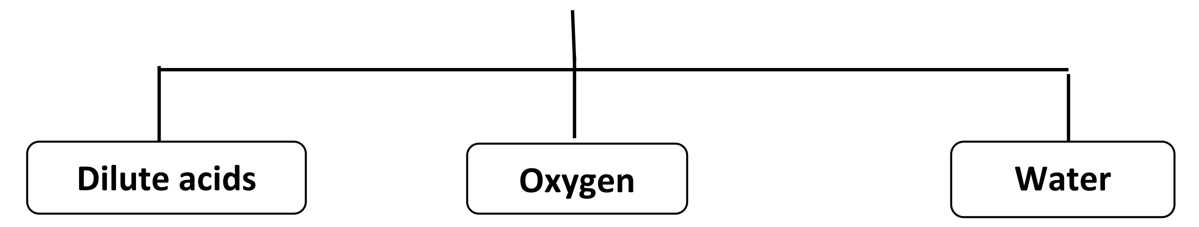
In groups:

In metallic groups:

- ☒ The metallic character increases as we go downwards within a group.
- ☒ Therefore in group 1A . Lithium is the weakest metal while cesium is the strongest metal.



The chemical properties of metals :



1-Reaction with dilute acids :

Activity 1 Steps	Put few copper turnings in a test tube and add dil. HCl acid
Observation	No gas evolves.
conclusion	Inactive metals such as **copper don't react with acids,** no gas evolves. $Cu + HCl \xrightarrow{dilute}$ No reaction



Copper in hydrochloric acid

Steps	Put magnesium strip in a test tube and add dil. HCl acid
Observation	H_2 gas evolves.
conclusion	Active metals such as **magnesium react with acids** and hydrogen gas evolves. $Mg + HCl \xrightarrow{dilute} MgCl_2 + H_2$

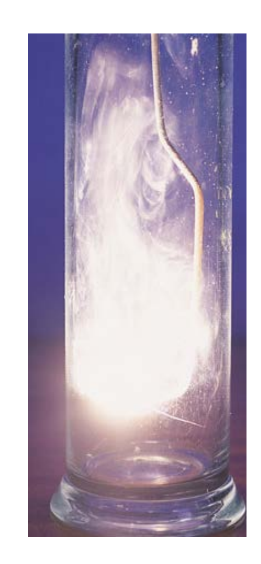


Magnesium in hydrochloric acid

2-Reaction with oxygen:

Activity 2

Steps	Ignite one end of a magnesium strip until it burns then put it inside a jar filled with oxygen gas.
Observation	The magnesium strip burns with a bright light And white ashes are formed.
conclusion	**magnesium (Mg)** reacts with **oxygen** giving magnesium oxide which is a **metal oxide** $2Mg + O_2 \xrightarrow{\Delta} 2MgO$ **(Magnesium oxide)**



3-Reaction of metal oxide with water:

Activity: 3

Steps	Add some water to the produced substance (magnesium oxide) then add drops of violet litmus solution
Observation	* Magnesium oxide dissolves in water * Litmus paper turns blue
Conclusion	Magnesium oxide dissolves in water giving magnesium hydroxide (**metal hydroxide)** which is a base &turns litmus solution **blue.** $MgO + H_2O \longrightarrow Mg(OH)_2$ (**Magnesium hydroxide**)



The following table summarizes the reaction of metals with oxygen:

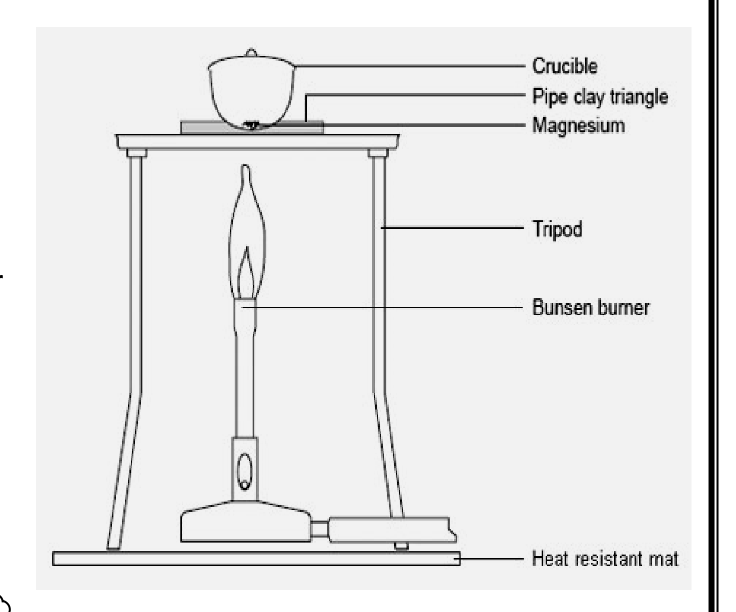
	Magnesium (Mg)	Iron (Fe)
step(1) reaction with oxygen	Magnesium + oxygen → magnesium oxide $2Mg + O_2 \rightarrow 2MgO$	Iron + Oxygen →Iron oxide
Step (2) add water to the products	$MgO + H_2O \rightarrow Mg(OH)_2$ Magnesium Hydroxide Dissolves in water	$FeO + H_2O$ ↓ Doesn't dissolve in water
Use litmus paper for detection of the acidity or alkalinity of the resulting solution	Magnesium hydroxide + Drops of litmus solution ↓ Changes to blue	

Conclusion:

1- Metals react with oxygen giving metal oxides which are known as basic oxides.

2- Some metal oxides dissolve in water like magnesium oxide, other metal oxides do not dissolve in water like iron oxide.

3- Magnesium hydroxide turns litmus paper into blue.



4-Reaction with water:

The chemical activity series is a list of metals arranged descendingly according to their chemical activity.

The following table shows the reaction of metals with water:

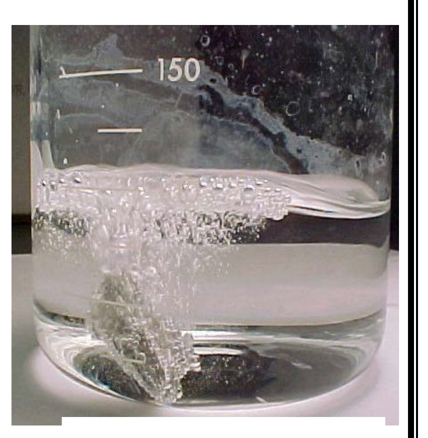


sodium in water

Metals	Reaction with water
Potassium K **Sodium Na**	They react instantly with water and hydrogen gas evolves burning with pop sound.
Calcium Ca **Magnesium**	They react very slowly with cold water.
Zinc Zn **Iron Fe**	They react with water vapour at high temperatures only.
Copper Cu **Silver Ag**	They don't react with water.



Calcium



Calcium in water

Cleaning silver tools:

Old silver tools rust therefore they are cleaned by soaking them in boiling water that contains Baking soda powder for 15minutes. drying the silverware with a piece of wool will make it shiny.



Old silver tool





Sodium bicarbonate

2-Non-metals

- They are the elements with **more than four electrons** in their outermost energy level.
- **In a chemical reaction they gain electrons** and form **negative ions**.
- The **charges** on the negative ion equal the **number of gained electrons**.
- The **electronic structure** of the negative ion is similar to that of the **inert gas** that follows the non-metal in the periodic table.

Examples :

1-Phosphorous atom ($_{15}P$) 2,8,5 → Gains 3electrons → **Phosphorous ion. (P^{-3})** 2, 8, 8

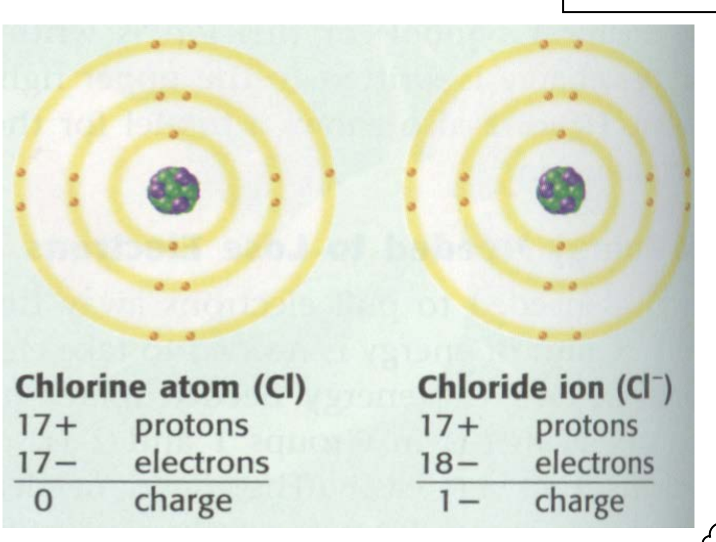
Similar to **Argon ($_{18}Ar$)**

2-Sulphur atom ($_{16}S$) 2, 8, 6 → Gains 2electrons → **Sulphur ion (S^{-2})** 2, 8, 8

Similar to **Argon ($_{18}Ar$)**

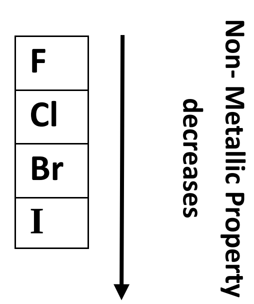
3-Chlorine atom ($_{17}Cl$) → Gains 1 electron → **Chlorine ion (Cl^-)** 2, 8, 8

Similar to **Argon ($_{18}Ar$)**



In non- metallic groups:

- The non-metallic property decreases as we go downwards within the group .
- In group 7 A , Flourine is the strongest non-metal while iodine is the weakest.




Fluorine gas in a container

3-Metalloids (semi-metals):

- They have the properties of both metals and non-metals.
- The number of electrons in their outermost levels vary from 3 to 6 as shown in the table :

Metalloid	Number of electrons in the outer energy level
1-Boron ($_5B$)	3
2-Silicon ($_{14}Si$)	4
3-Arsenic ($_{33}As$)	5
4-Tellurium ($_{52}Te$)	6

boron

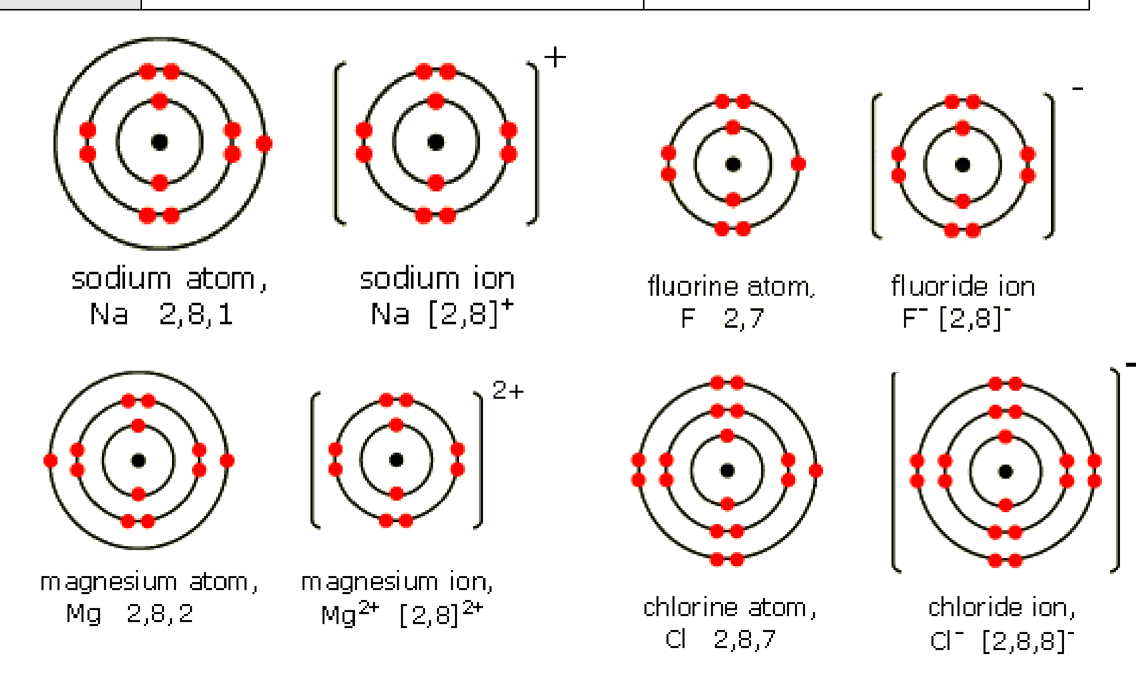


arsenic


silicon


tellurium

Points of comparison	Metals	Non-metals
1-The outermost energy level.	Less than 4 electrons.	More than 4 electrons.
2-In a chemical reaction.	Lose electrons and change into (+ve) ions.	Gain electrons and change into (-ve) ions.
3-Examples :	Sodium ($_{11}Na$) Magnesium ($_{12}Mg$)	Fluorine ($_{9}F$) Chlorine ($_{17}Cl$)



Comparison between the positive ion (cation) and the negative ion (anion).

Points of comparison	**The positive ion (cation)**	**The negative ion (anion)**
Definition	It is an atom of a metallic element that **lost an electron or more** during a chemical reactions.	It is an atom of a non-metallic element that **gained an electron or more** during a chemical reactions.
Charge	It carries **positive charges** equal to number of lost electrons.	It carries **negative charges** equal to the number of gained electrons.
Examples	**Na^{+}, Mg^{+2}, Al^{+3}**	**Cl^{-}, O^{-2}, P^{-3}**

Chemical properties of non-metals :

1-Reaction with dilute acids :

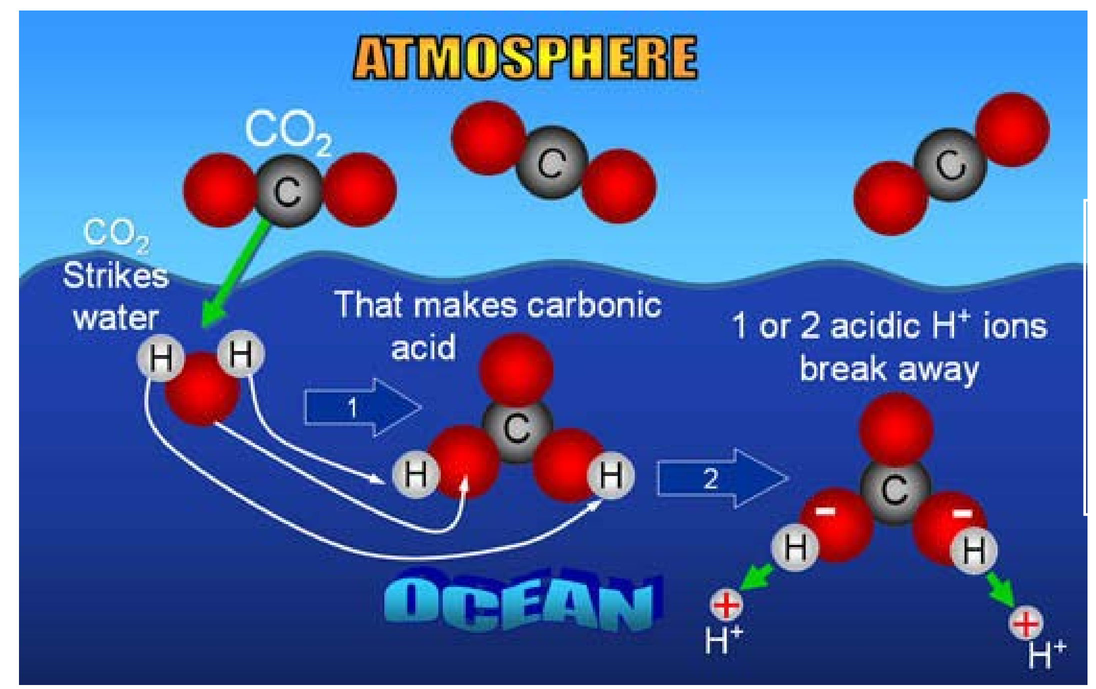
Activity 1

Steps	1. Put a piece of coal (carbon) in a test tube and a piece of sulphur in another tube. 2. Add dilute HCl to each tube.
Observation	No reaction takes place.
conclusion	Non-metals (such as carbon and sulphur) don't react with dilute acids.

2-Reaction with oxygen :

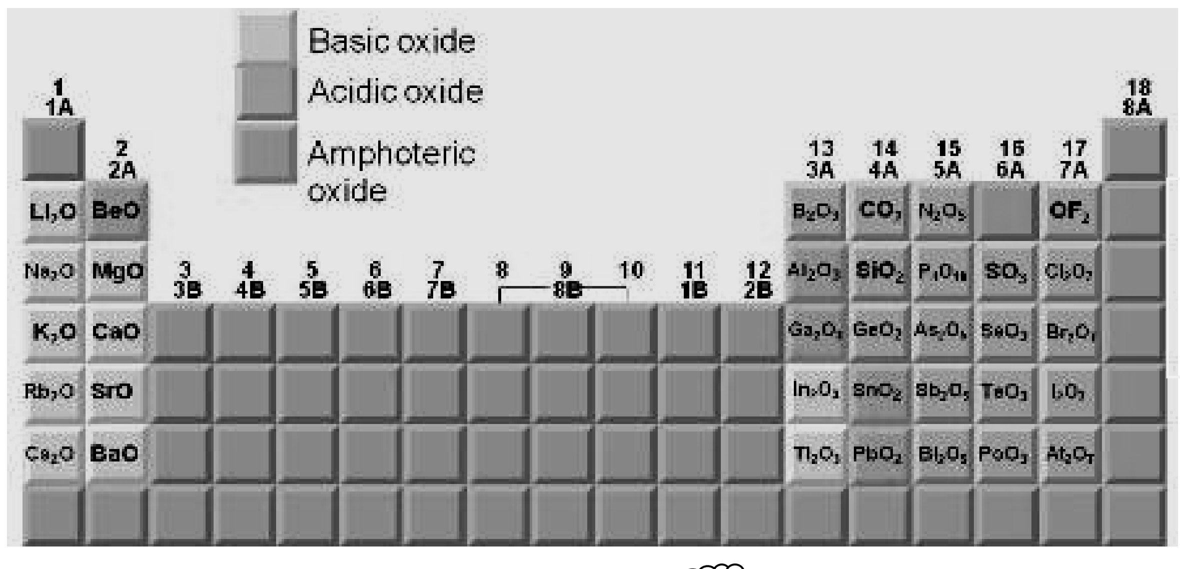
Activity 2

Steps	1. Burn a piece of coal in a burning spoon. 2. Put the burnt coal in a cylinder & add some water. 3. Add a blue litmus paper to the contents of the cylinder.
Observation	The litmus paper turns red
conclusion	Non-metals such as carbon react with oxygen giving non-metal oxides **"acidic oxides"** $C + O_2 \longrightarrow CO_2$ **carbon dioxide** **Non-metals (acidic) oxides dissolve in water forming acids** which turn blue litmus paper red. $CO_2 + H_2O \longrightarrow H_2CO_3$ **carbonic acid**



CO_2 coming from car exhaust dissolves in water &increases the acidity of sea water

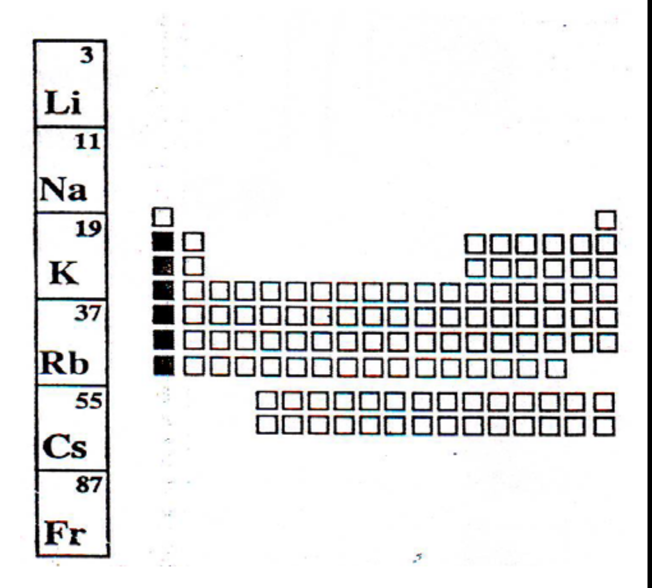
Basic oxides	Acidic oxides
1. They are metal oxides. 2. They are formed by the reaction of metal with oxygen 3. Some of them dissolve in water giving alkalis. 4. Their solutions turn litmus paper into blue. 5. Examples: Na_2O & MgO	1. They are non-metal oxides. 2. They are formed by the reaction of non-metal with oxygen. 3. They dissolve in water giving acids. 4. Their solutions turn litmus paper into red. 5. Examples: CO_2 & SO_2



Oxides of representative elements

Lesson 3: The main groups in the modern periodic table

1-Alkali metals (1A)



*They are located on the **left side** of the modern periodic table.

*They are the **first** group of **s-block.**

* **The elements** in group (1A) are:

1. Lithium ($_3Li$)
2. Sodium ($_{11}Na$)
3. Potassium ($_{19}K$)
4. Rubidium ($_{37}Rb$)
5. Cesium ($_{55}Cs$)
6. Francium($_{87}Fr$)

***Alkali metals react** with water forming **alkaline solutions.**

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2\uparrow$$

Sodium hydroxide
Alkaline solution

All alkali metals share the following properties:

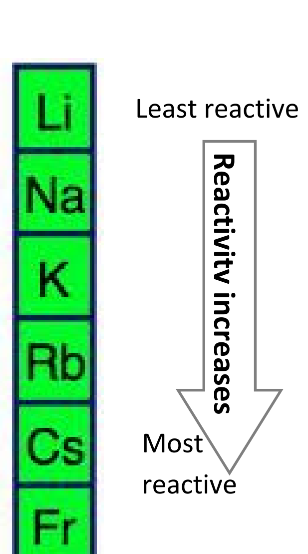
1- They have **one electron** in the outermost energy level, therefore they are monovalent.

2-They **lose an electron** during the chemical reactions forming **positive ions**, with one positive charge.

Na	$\longrightarrow$	**Na^+ + e-**
Alkali metal		**Positive ion**

3-They are **very active elements** so, they are kept under the surface of kerosene or paraffin oil to prevent their reaction with moist air.

4-Their **chemical activity increases as the atomic size increases,** therefore **Cesium (Cs) which has the largest atomic size** is considered **most active metal.**



5-They are **good conductors of heat and electricity.**

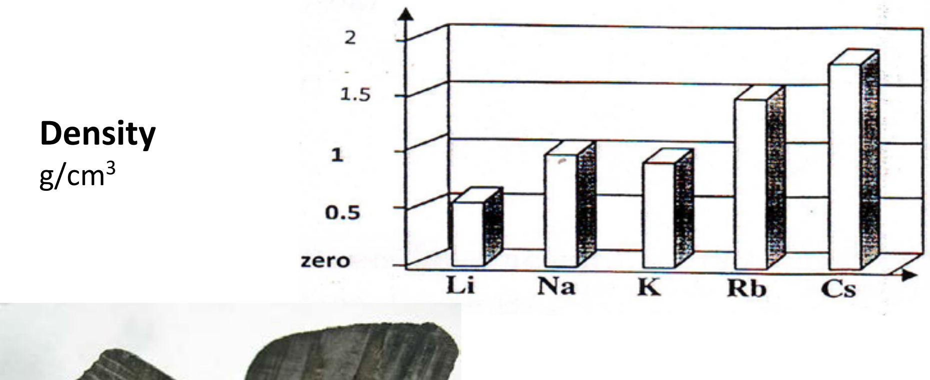
6-Most of them have **low density.**

From the following figure, we can conclude that :

<u>Lithium (Li), Sodium (Na), and Potassium (K)</u> are less dense than water therefore they **<u>float</u>** on water surface

Note: the density of water is 1g/cm^3

<u>Rubidium (Rb) and Cesium (Cs</u><u>)</u> are more dense than water & they **<u>sink</u>** in water.





Lithium

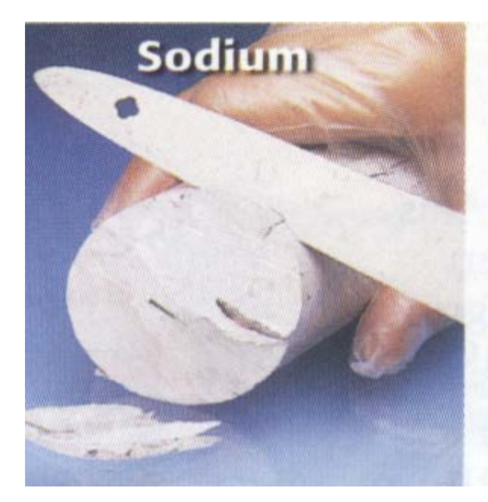


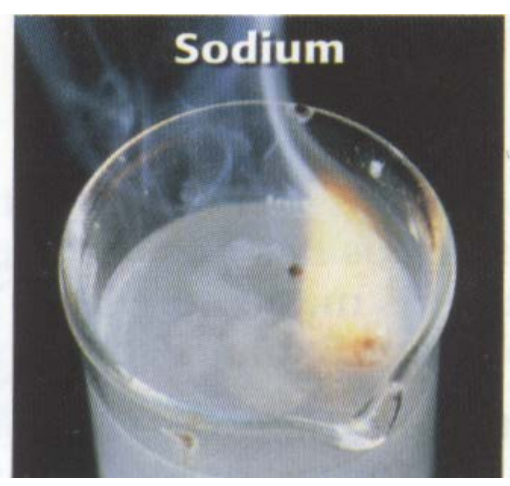


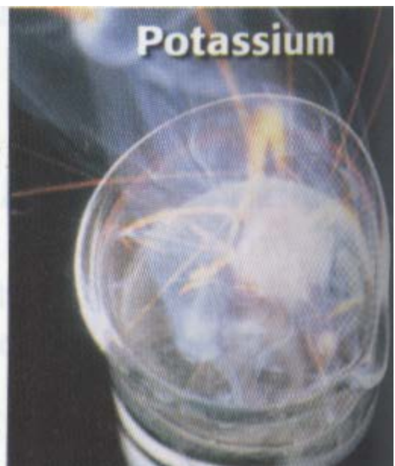
Potassium

Rubidium

Activity to show the reaction of alkali metals with water :







Observation :

Both sodium and potassium react with water and hydrogen gas evolves which burns with a pop sound.

The reaction of potassium with water is stronger than that with sodium.

Conclusion:

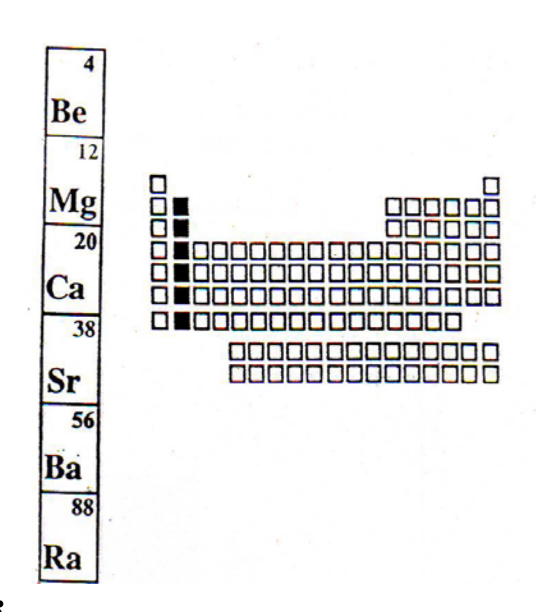
Potassium is more reactive with water than sodium.

$2Na + 2H_2O \longrightarrow 2NaOH + H_2 \uparrow$

$2K + 2H_2O \longrightarrow 2KOH + H_2 \uparrow$

The **atomic size of potassium is bigger than sodium, therefore potassium is more reactive with water .**

2-Alkaline earth metals (2A)



-They are located on the **left side** of the periodic table .

-They are the **second group of s-block** after group (1).

-The elements of this group are:

1. Beryllium ($_4Be$).
2. Magnesium ($_{12}Mg$)
3. Calcium ($_{20}Ca$)
4. Strontium ($_{38}Sr$)
5. Barium ($_{56}Ba$)
6. Radium($_{88}Ra$)

Alkaline earth metals share the following properties:

1-They have **two electrons** in their outermost energy levels, therefore they are **divalent**.

2-They **lose 2 electrons** during the chemical reactions forming **positive ions, with two positive charges.**

Mg	$\longrightarrow$	Mg^{2+}	+	$2e^-$
Alkaline earth metal		positive ion		

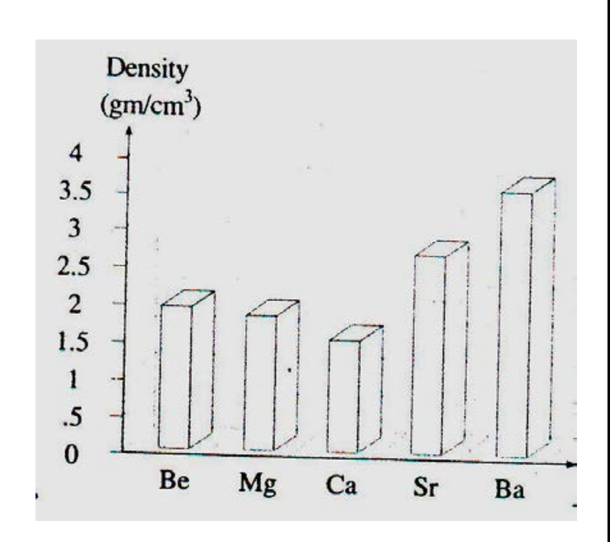
3-Their **chemical activity** is **less** than alkali metals ,therefore, they are not kept under the surface of kerosene or paraffin oil.

4-As the atomic size increases, so does the chemical activity , because the loss of electrons becomes easier.

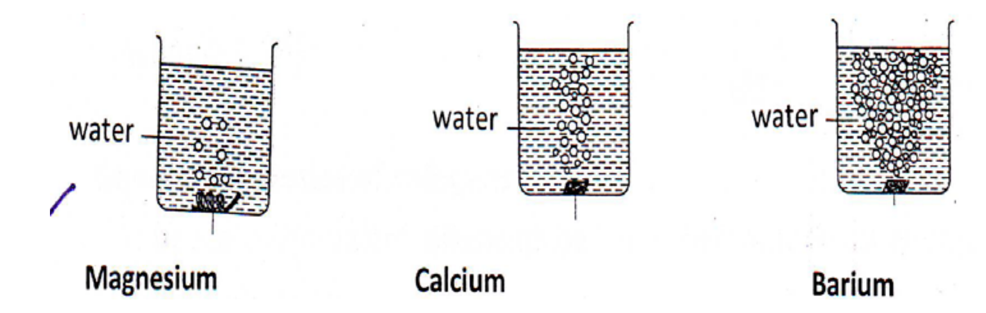
Barium ($_{56}Ba$) is more active than Calcium ($_{20}Ca$)

5-They are **good conductors of heat and electricity.**

6-Their **densities** are **higher** than alkali metal densities & higher than water, therefore they **sink** in water.



The reaction of alkaline earth metals with water :



Observation :

The number of bubbles formed in case of barium is greater than that in case of calcium.

The number of bubbles in case of calcium is greater than that in case of magnesium.

Conclusion :

Barium is more active than calcium.

Calcium is more active than magnesium. **(Ba>Ca>Mg)**



Calcium salts support your bones





3- Halogens

They are located on the **right side** of the Modern periodic table before the inert gases.

They are elements of **group (17) in p-block**.
This group includes **five elements:**

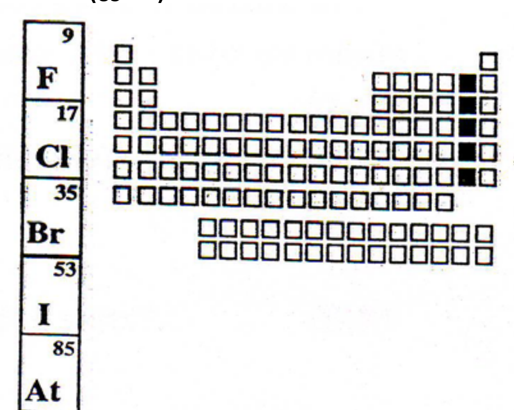
-Fluorine ($_{9}F$)
-Chlorine ($_{17}Cl$)
-Bromine ($_{35}Br$)
-Iodine ($_{53}I$)
-Astatine ($_{85}At$)

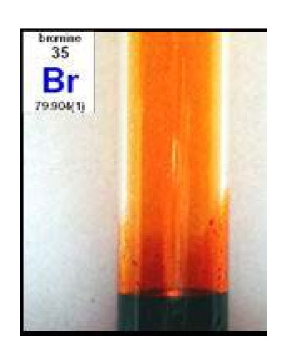


Iodine solution is used as disinfectant



Iodine is a dark gray solid







Chlorine is yellow gas

General properties of halogens :

Element	Electronic configuration
$_{2}F$	2,7
$_{17}Cl$	2,8,7

1-They are mono-valent elements because their outermost energy levels have 7 electrons.

2-They gain one electron during chemical reaction and form a negative ion with one negative charge.

Br	**+**	**e^-**	**⟶**	**Br^-**
(halogen)				**negative ion**

3-They exist in the form of **diatomic molecules**. (Fl_2, Cl_2, Br_2, I_2)

4-Their physical state differ, fluorine, chlorine are gases , bromine is a liquid , iodine is solid.

5-They are **active elements** therefore they **do not exist in nature in elementary state** but they are found combined with other elements except Astatine (At) which is prepared artificially.

6-They react with metals forming **salts**.The name halogen means **"Forming salts".**

$$2K + Br_2 \longrightarrow 2KBr$$

potassium bromide

$$2Na + Cl_2 \longrightarrow 2NaCl$$

Sodium chloride

7-Each element replaces the element below it from its salt solution.

$$Cl_2 + 2KBr \longrightarrow 2KCl + Br_2$$

Chlorine Potassium bromide Potassium chloride Bromine

$$Cl_2 + 2NaBr \longrightarrow 2NaCl + Br_2$$

Chlorine Sodium bromide Sodium chloride Bromine

$$Br_2 + 2KI \longrightarrow 2KBr + I_2$$

Bromine Potassium iodide Potassium bromide Iodine

General characteristics of inert gases :

1-The **valency of inert gases = zero.**

Their outermost energy level is saturated with electrons, therefore they do not gain or lose Electrons in the ordinary conditions , therefore they are called inert gases (Noble gases).

Elements have different uses according to their properties.

1- Charcoal

It is placed in the refrigerator to absorb & get rid of gases of undesirable odors.

2-Radioactive cobalt (60) is used in food preservation,

It radiates gamma rays that stop the reproduction of microbes without harming the human body.

<u>3-Silicon is a metalloid</u> used in the electronic devices such as computers, because it is a semi- conductor.



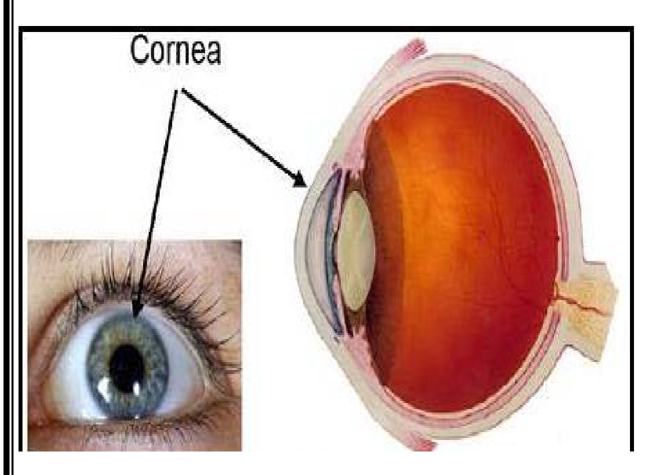


<u>4-Liquid nitrogen</u>

The cornea is the transparent front part of the eye & its damage makes vision unclear.

The cornea from a dead person is transferred in liquid nitrogen. The low boiling point (-196^0).

Of nitrogen preserves the eye cornea from decay. The cornea is then transplanted in a person who needs it to gain clear sight again.

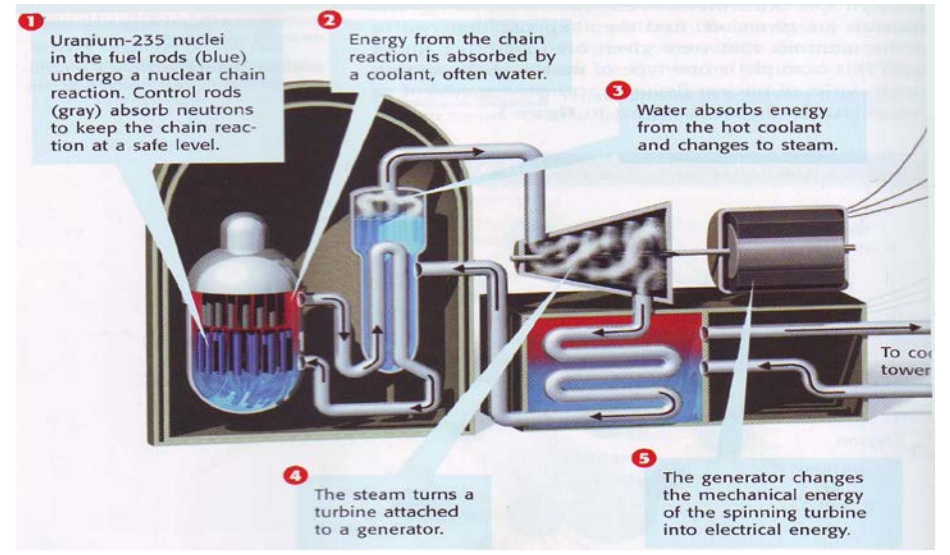






5-<u>Sodium,</u> a good conductor of heat absorbs heat resulting in the nuclear reactor.

Heat is then used to evaporate water. The energy of the vapour is used to generate electricity.

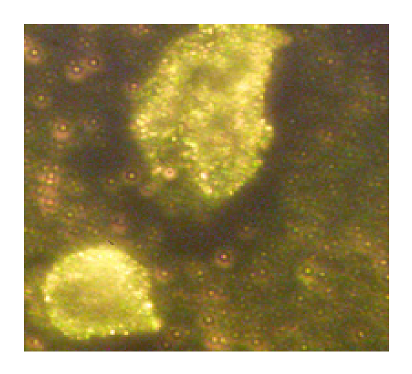


Enriching information for reading



Mostafa El-Sayed (born 8 May 1933 - Zifta, Egypt) is

- an Egyptian-American chemical physicist,
- a leading nanoscience researcher,
- a member of the National Academy of Sciences and a US National Medal of Sciencelaureate.
- He developed gold nanotechnology which was used to treat cancer .
- **Nanotechnology** study matter on an atomic and molecular scale & develops materials or devices sized between 1 to 100 nanometre.
- **1 nanometer =** one billionth of a meter (1 nm = 10^{-9} m)



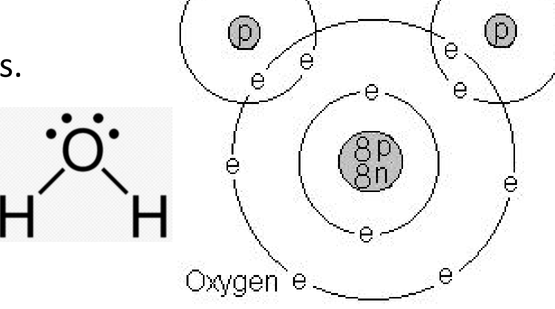
Gold nanoparticles stick to cancer cells and make them shine.

Lesson 4: Water

The importance of water:

1-Water is used in personal, industrial & agricultural uses.

2-Water resources are rivers, seas , oceans, rain , wells & springs .



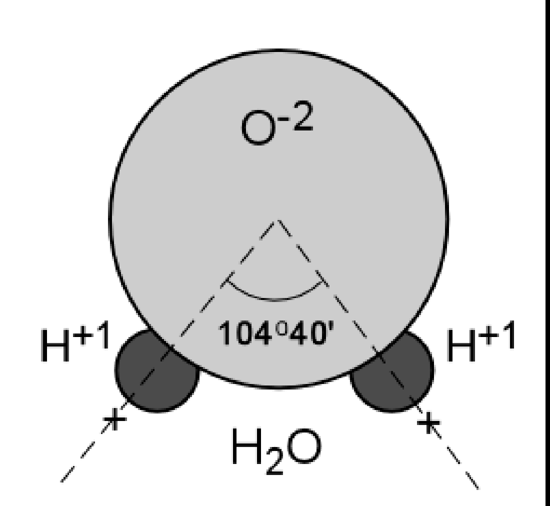
The chemical structure of water:

1- Each water molecule is made of 2 hydrogen atoms & one oxygen atom.

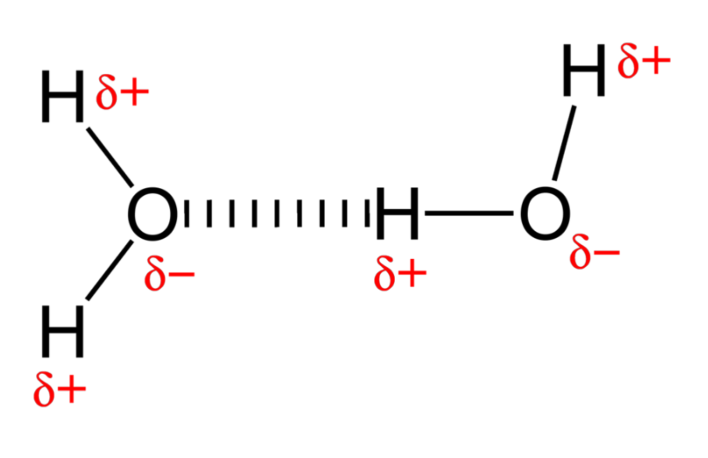
2- Each hydrogen atom is bonded to the oxygen atom by a single covalent bond.

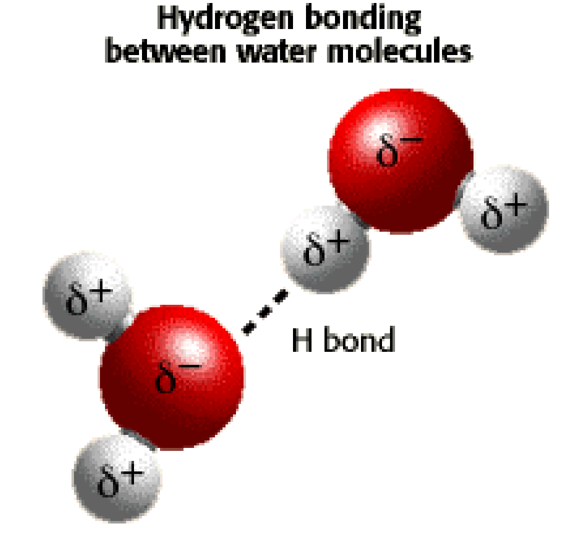
3- The angle between the 2 atoms is 104.5°

4- Oxygen electronegativity is high in comparison with hydrogen, therefore oxygen pulls the Electrons of the bond towards it. A partial negative change appears on oxygen & a partial negative charge appears on the hydrogen atom, therefore water is a polar compound.



5- Weak electrostatic attraction occurs between an oxygen atom from one molecule & hydrogen atom in another water molecule. This attraction is called the **hydrogen bond**. The hydrogen bond is weaker than the covalent bond. Hydrogen bonds readily form & break.





The properties of water:

1- Water is a good polar solvent:

Activity 1

Dissolved NaCl

Sodium ion, Na^+

Water molecule, H_2O

Chloride ion, Cl^-

- **Purpose**

To identify water as a polar solvent

- **Materials**

3 Beakers, some salt, some sugar, some cooking oil, 3 spoons for stirring

- **Steps:**





- Put similar amounts of water in 3 beakers.
- Put some salt in the 1st beaker.
- Put some sugar in the 2nd beaker.
- Put some oil in the 3rd beaker.
- Stir the contents of each beaker.

- **Observation**

Sugar & salt dissolve in water, but oil doesn't dissolve in water.

- **Conclusion**

Water dissolves:

1. **ionic compounds (such as table salt)**
2. **Some covalent compounds (such as sugar)** because they form hydrogen bonds with water
3. **Water doesn't dissolve covalent compounds (such as oil)** because they don't form hydrogen bonds with water.

2-High boiling point and high melting point:

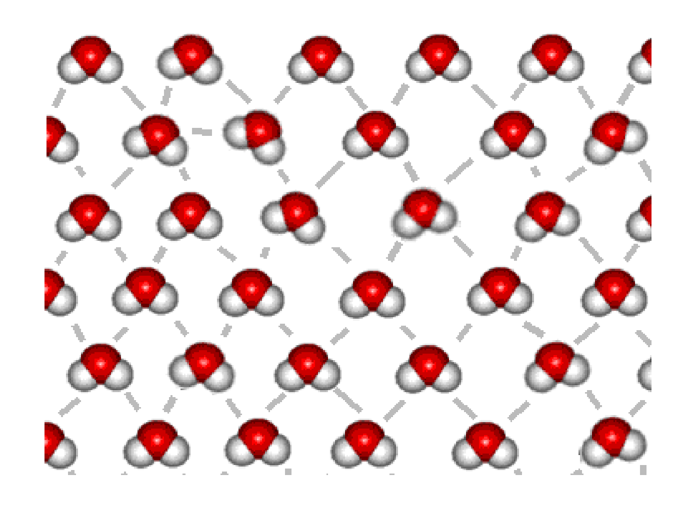
- ✓ The boiling point is the temperature at which liquid (water) becomes vapour by heating. Covalent compounds usually have low boiling points.
- ✓ The boiling point of water is considered high (100°C) because of the hydrogen bonds between water molecules which require some additional energy to break before water evaporates.
- ✓ The melting point is the temperature at which a solid substance starts turning into liquid. The melting point of water is high (0°C) , again this is explained by the presence of hydrogen bonds between its molecules.

3-The density of ice is lower than that of water.



- ✓ By cooling water below 4°C, water molecules bond by hydrogen bonds forming hexagonal crystals with big size.
- ✓ Below 0°C, water freezes. Ice is lighter than water therefore it floats on the surface of water lakes in polar regions.
- ✓ Aquatic organisms live in liquid water under the frozen surface.

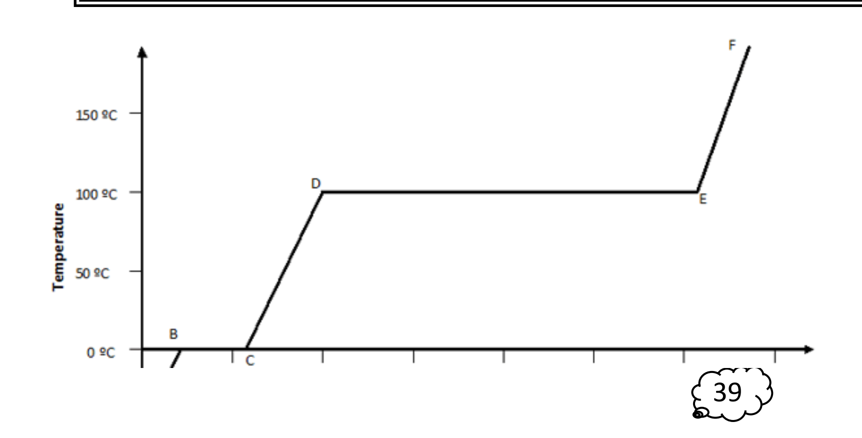


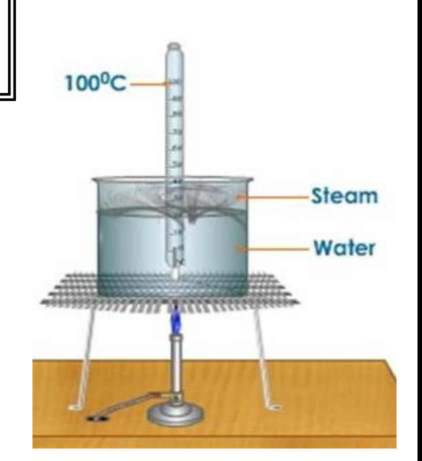


4-High latent heat of vaporization.

- ✓ During evaporation, the temperature of boiling water stays constant at 100°C for a while.
- ✓ Heat is absorbed to break hydrogen bonds & does not show on the thermometer.
- ✓ Water is an excellent fire extinguisher because it absorbs a great amount of heat from the burning material, while water is evaporating.

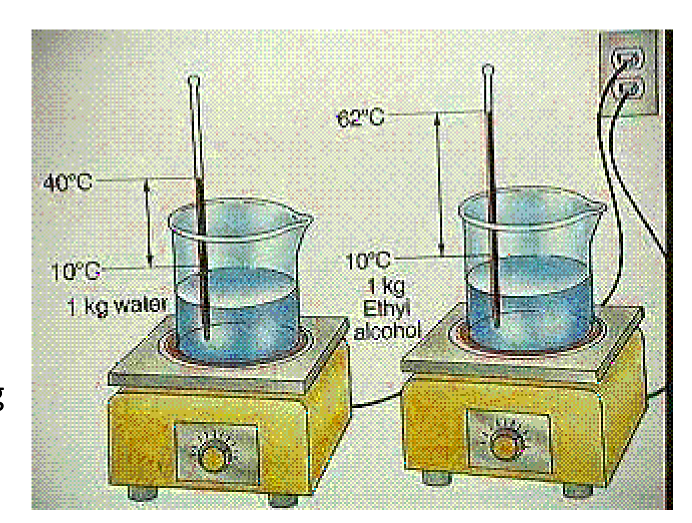
Latent heat is the heat needed to change 1 kg of liquid to vapor without change in temperature.





5-High specific heat

Specific heat is the heat needed to raise the temperature of 1 kg of a substance by 1°C.



- ✓ Water has high specific heat & therefore it can absorb a large amount of heat with a minimal change in temperature.
- ✓ Water forms 70% of the human body, therefore our bodies can absorb large amount of heat during summer without a big change in the body temperature.
- ✓ The body temperature has to stay constant for the body to function well.

6-Weak ionization

Ionization is the change of a compound into ions. Water is weakly ionized & is present in a Neutral state.

Ionization of water occurs according to the following equation

$$H_2O \longrightarrow H^+ + OH^-$$

7-Neutral effect on red & blue litmus papers

Since ionization of water gives equal number of hydrogen ions responsible for the acidic property & hydroxide ions responsible for the basic property.

8-Water electrolysis

Activity 2

- ➢ ***Purpose:*** Analyzing water into its 2 elements by electrolysis.

➢ ***Tools:*** Hoffman voltameter apparatus & some acidified water. The acid increases the conductivity of water.

➢ ***Steps:*** Connect the apparatus with the 2 poles of a battery.

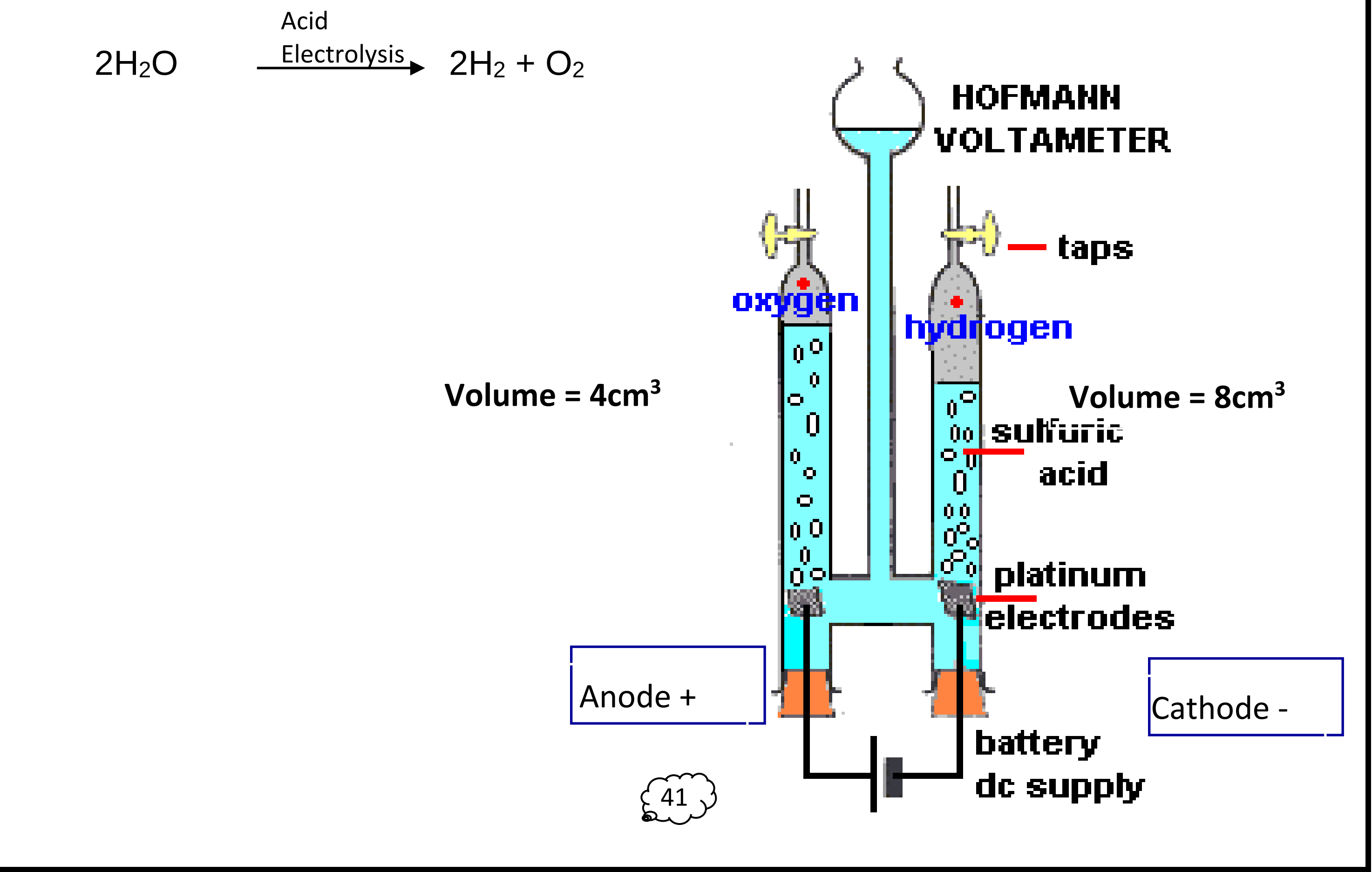
➢ ***Observation***

- ❖ Gases evolve at the 2 ends of the apparatus.
- ❖ The volume of the gas formed at the cathode is double the volume of the gas formed at the anode.
- ❖ A glowing splint is placed near the tip of each pole. The glowing of the splint increases.
- ❖ The gas at the cathode burns with pop sound.

➢ ***Conclusion:***

- ❖ Water is analyzed by electricity into its elements oxygen & hydrogen.
- ❖ Oxygen evolves at the anode, while hydrogen evolves at the cathode.

$$2H_2O \xrightarrow[\text{Electrolysis}]{\text{Acid}} 2H_2 + O_2$$



<u>Water pollution:</u>



1- Fertilizers are chemical compounds used by farmers to increase the growth of plants. They dissolve in irrigation water & are transferred to river water. Fertilizers increase the growth of unicellular organisms that live in the water (algae).
   <u>Algae deplete oxygen dissolved in water & deprive aquatic organisms from oxygen, causing their death.</u>

2-<u>Detergents</u> (such as liquid soap) are poured along other industrial materials in river water **<u>causing the death of algae. Fish which feed on algae die also.</u>**

<u>Water pollution comes from 4 sources:</u>

<u>1-Biological pollution:</u>

Getting rid of human wastes in water resources transmits germs from sick people to healthy ones who use polluted water.

<u>Bilharzias, typhoid & hepatitis are some of the diseases transmitted by using polluted water.</u>

<u>2-Chemical pollution:</u>

Factories have liquid wastes full of chemicals & get rid of them in river water.

The fish absorb chemical wastes & are contaminated. Eating fish polluted with lead damages humans' brains. Drinking large amount of water polluted with mercury causes blindness.

<u>Drinking water polluted with arsenic causes liver cancer.</u>

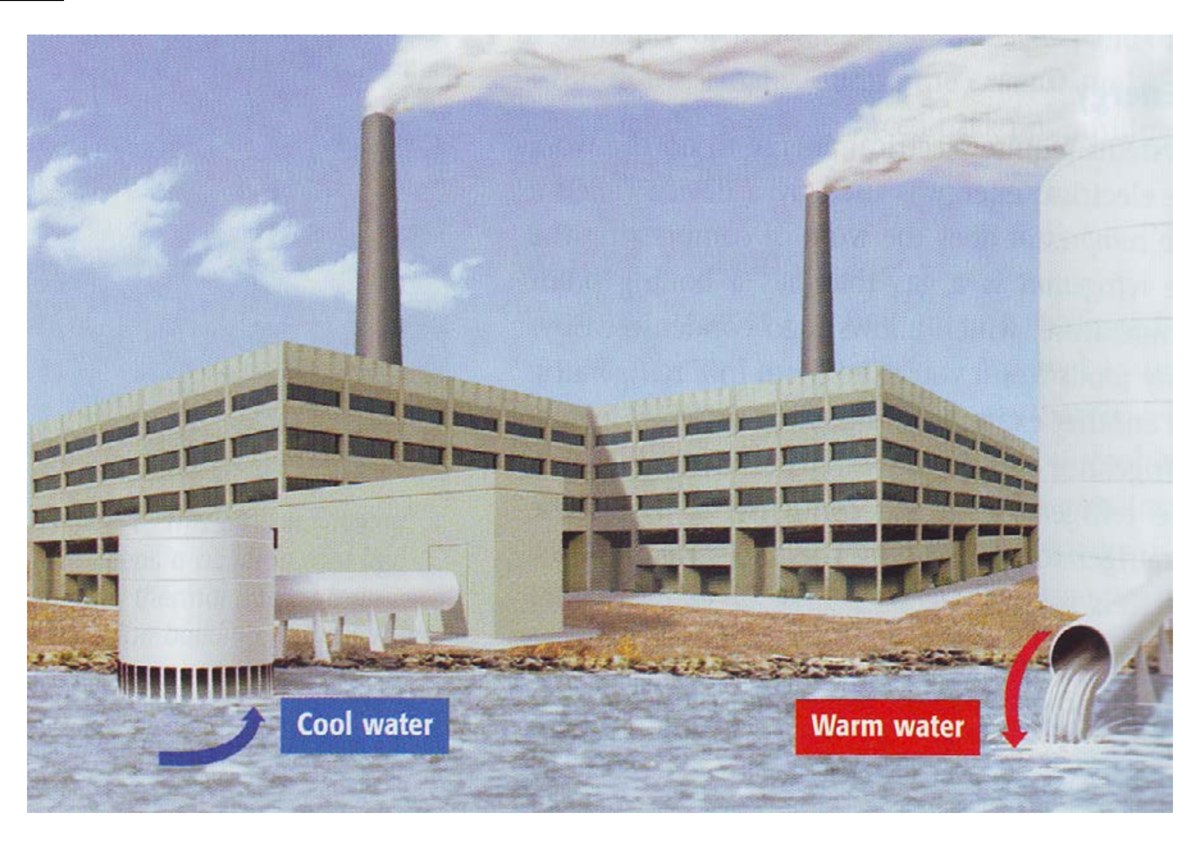
<u>3-Pollution by radioactive materials:</u>

Nuclear reactors produce **<u>radioactive wastes</u>** (materials which produce harmful radiations). These wastes are dumped in water resources or buried deep in the earth where they **<u>contaminate ground water.</u>**

4-Thermal pollution:

Nuclear reactors use water from nearby rivers to absorb the heat that result during their work. Hot water is returned back to the river.

The heat reduces the amount of oxygen dissolved in water & therefore causes the death of marine organisms.



Reducing water pollution

1-Sewage is treated before being thrown in water resources.

2-Chemical analysis of the contents & quality of water is done periodically.

3-The media should inform the people about reducing pollution.

4-Disinfecting water tanks periodically.

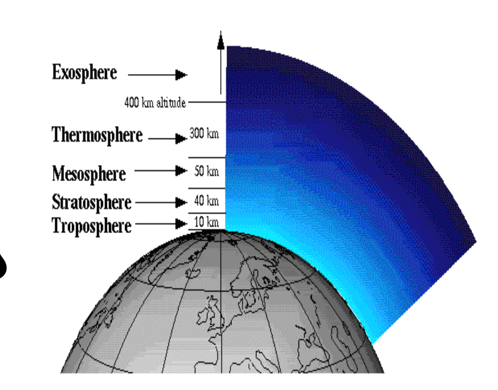
5-Don't put tap water in plastic bottles.

Tap water contains chlorine to kill germs. Chlorine reacts with plastic & releases poisons in the water causing cancer.

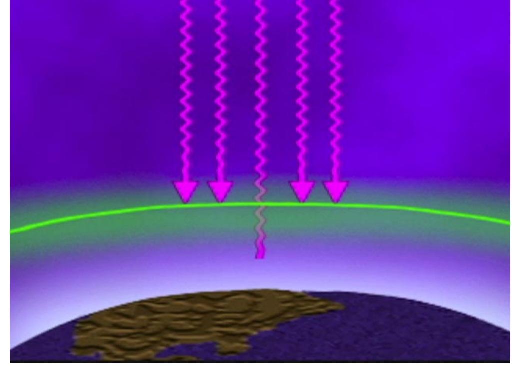


Unit 2: The Atmosphere and Protecting planet Earth

Lesson 1: The atmospheric layers



Lesson 2 : Erosion of ozone layer and global warming.



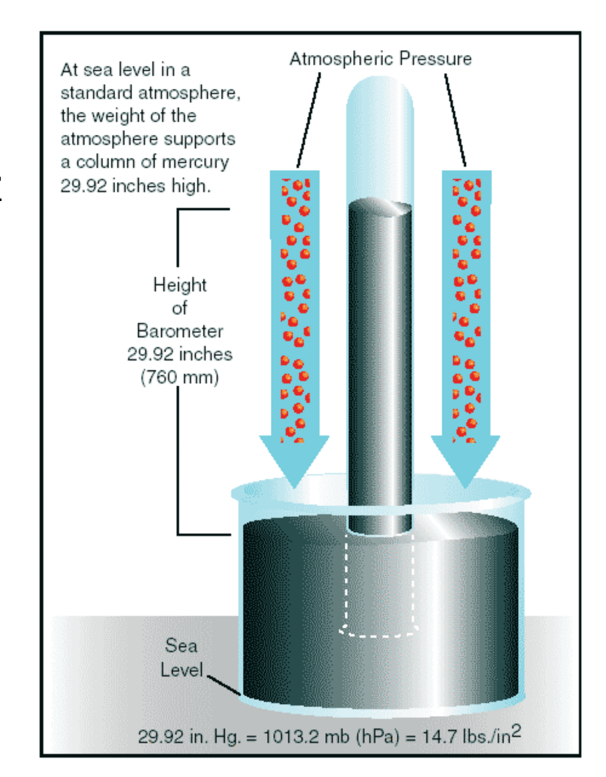
Lesson 1

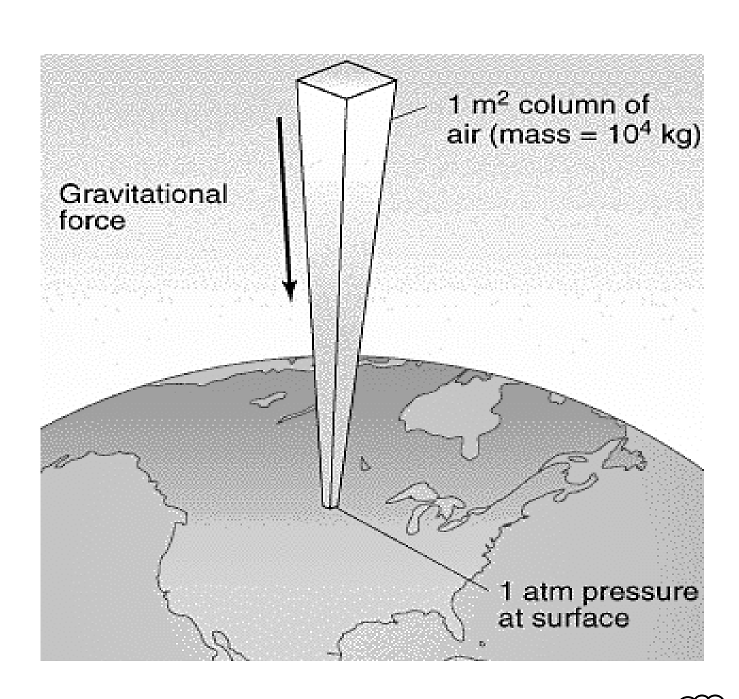
The atmospheric layers

Atmospheric pressure :



- The air that surrounds the earth is called **the atmosphere**.
- The atmosphere extends about 1000 km above the sea level.
- This atmosphere has mass & therefore **it exerts a vertical force on the surface of the earth.**
- The push of the air on the surface of the earth is called the **atmospheric pressure.**
- **Atmospheric pressure** is defined as **the weight of air column pushing over a unit area ($1cm^2$ or $1m^2$)**
- **The tools that measure** the atmospheric pressure are the **barometers.**
- The unit of atmospheric pressure is the **bar or millibar**.





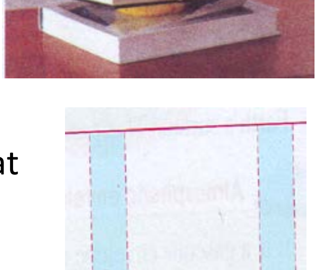
- **<u>Why do we study the atmospheric pressure?</u>**

  Variation of the atmospheric pressure affects weather phenomena.

- **<u>What affects the atmospheric pressure ?</u>**

  As the weight of books in your bag increase ,they put more pressure on your shoulders & back.

- Examine the following drawing which represents 2 persons standing at different heights. The column of air on the person standing on the surface of the earth is bigger (has more mass) & therefore **<u>the atmospheric pressure at sea level is higher.</u>**



- As we go higher (**<u>the altitude increases) , the atmospheric pressure decreases.</u>**
- Due to the force of gravity , most of the air concentrates near the surface of the earth . Most of the mass of the air lies within range of 16 km from the surface of the earth.

Instruments measuring the atmospheric pressure:

The instrument	Figure	Function
Aneroid Barometer		Measures the atmospheric pressure which is needed to predict the weather.
Altimeter		Pilots in aeroplanes use it to measure the height from sea level based on the atmospheric pressure.

Atmospheric pressure maps

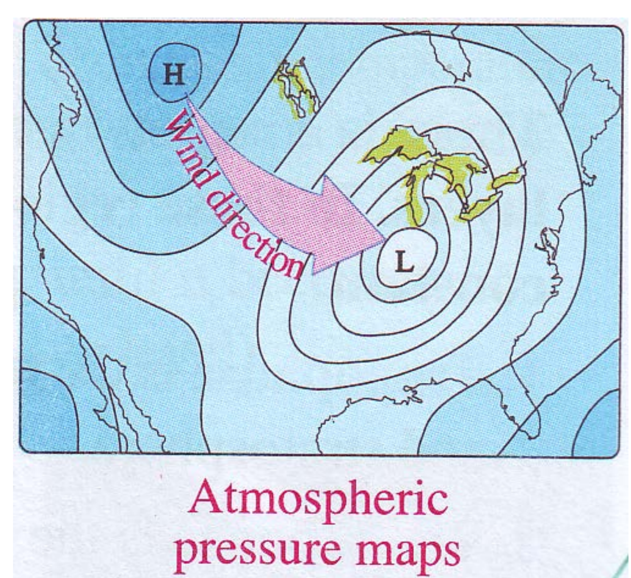
1-Scientists join **points of low atmospheric pressure** together & label the region with **letter L**. Points of **high atmospheric pressure** are joined with a line & labeled with **letter H** .

2-Such maps are called **atmospheric pressure maps**.

3-They are used to learn about the blowing of the wind.

4-**Wind blows from points of high atmospheric pressure to points of low atmospheric pressure.**

Isobar is a curved line that joins the points of equal pressure points in atmospheric pressure maps.

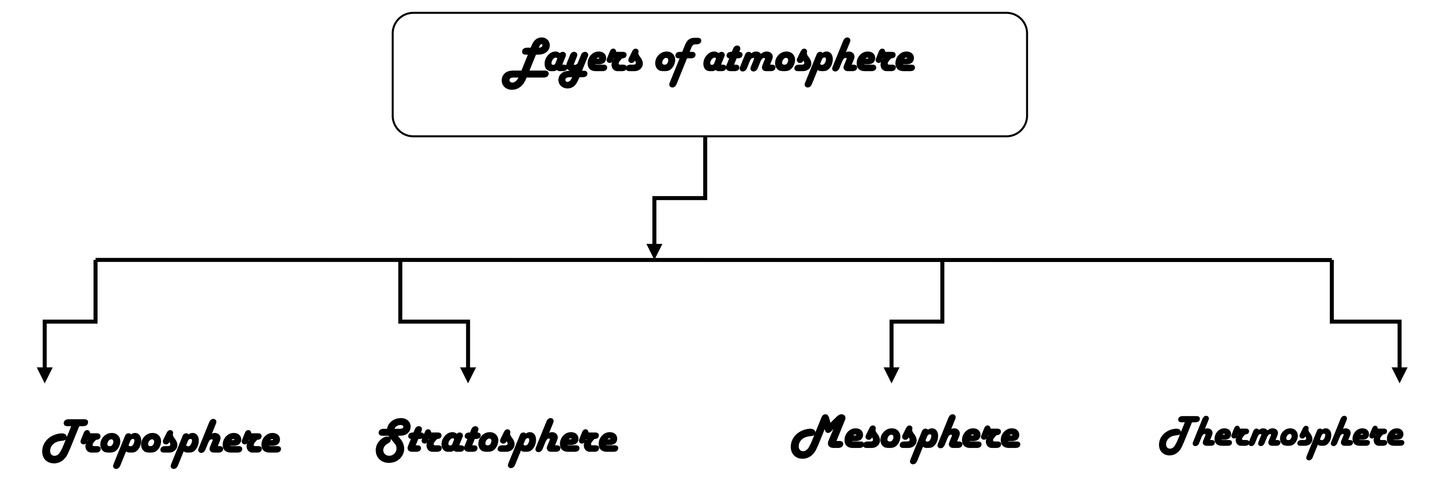


Atmospheric pressure maps

Layers of the atmosphere

As we go up from sea level, the pressure & temperature of the atmosphere changes. The atmosphere consists of **four layers** above sea level, classified according to:

1- **The change in atmospheric pressure.**
2- **The change in temperature.**



1-The Troposphere: is the **first layer** of atmosphere.

1. It extends from sea level to 13 km above sea level.
2. Since most of the mass of the air is in this layer, weather phenomena occur in this layer.
3. Rain, wind, storms & clouds are weather phenomena.
4. This layer got its name which means disturbance from the weather phenomena taking place in it.

1-As we go up one km away from sea level (earth's surface), the temperature decreases 6.5°C.

1. At the top of this layer the temperature becomes **-60°C**.
2. The **atmospheric pressure decreases as we go up** until it becomes 100mb.
   Because the **weight** of the air column **decreases** as we go up
3. It contains **99% of** atmospheric **water vapour** which organizes Earth’s temperature.
4. Hot air is less dense than cold air.
5. Hot air moves upwards & is replaced with colder air which moves downwards,therefore generating wind.

THERMOSPHERE
MESOSPHERE
STRATOSPHERE
TROPOSPHERE

Ionosphere (Aurora)
350 km
Mesosphere
Ozone Layer
90 km
50 km
Stratosphere
Tropopause
Troposphere
18 km
14 km
Earth

2-The Stratosphere *is* the **second layer** of atmosphere.

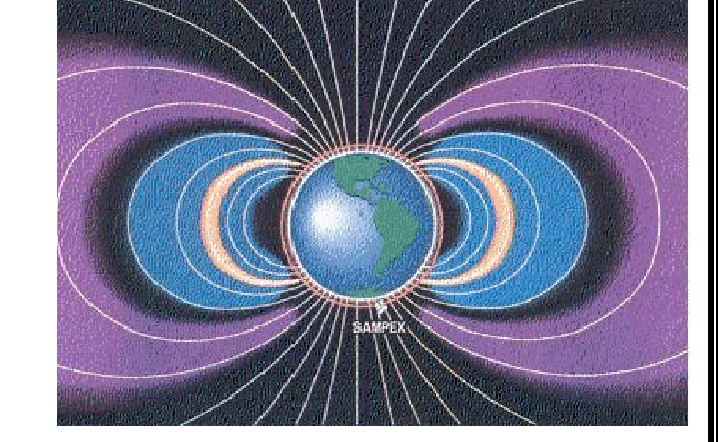
- It extends from the end of the troposphere (at a height of 13 km) till 50 km . Its thickness is **37Km.**
- As the height increases within this layer, the **temperature increases gradually from -60ºC to 0ºC** at the top of this layer because the ozone absorbs **ultraviolet rays** & emits heat.
- **The atmospheric pressure decreases** as we go up until it becomes **1mb** at its top.
- It contains the ozone gas layer & therefore is called the **ozonic atmospheric envelope.**
- The **ozone gas layer** extends between 20 to 40 km above the sea level.
- The absence of **clouds & wind turbulence** is why pilots fly their planes in the lower parts of this layer.
- Ozone gas absorbs ultraviolet radiations & protects living organisms on the earth from their harmful effect.

3-The mesosphere is the **third layer** of the atmosphere.

- It is the **middle layer** and the **coldest one.**
- It extends from the stratosphere (50 km) to the mesopause at a height of 85km above the sea level.
- It's 35 km thick.
- The **temperature decreases upwards** & reaches -90ºC at its top so, it is the **coldest layer.**
- **The atmospheric pressure decreases as we go up,** until it becomes 0.01 mb. at its top.
- Limited quantities of **helium and hydrogen** gases exist in this layer. This layer is almost vacuum (highly rarefied**).**
- **The friction between celestial bodies & the gases of this layer produce luminous streaks of light called meteors.**

4- The thermosphere is the **fourth layer** of atmosphere.

- This layer got its name from being the **hottest layer** of the atmosphere, since it's near the sun.
- It extends from the mesopause (at a height of 85 Km above sea level) to a height of 675Km above the sea level.
- It's 590 km thick.
- **The temperature increases upwards** until it reaches 1200°C at its top.
- Charged particles called **ions exist in the upper part** of this layer.The presence of ions extend up to 700Km.This part is known as the **ionosphere.**
- The ionosphere contains ions which **reflect radio waves** produced from T.V. & radio transmittion stations. Therefore **it has an important role in receiving wireless communications.**
- Two **magnetic belts** known as **Van-Allen belts** surround this layer scatter harmful charged cosmic radiations away from the earth.



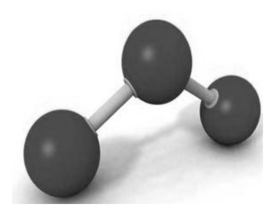
- The scattered rays cause the **Aurorora** phenomenon which are light curtains seen at the south & north poles.
- The **exosphere is where the atmosphere ends & space begins & where satellites orbit the earth.**
- Satellites transmit weather conditions and TV programs.





Lesson 2
Erosion of ozone layer and global warming

"وجعلنا السماء سقفاً محفوظاً وهم عن آياتها معرضون " (الأنبياء 32)



1-How is ozone formed?

The ozone layer contains **ozone gas (O_3)** . **Each molecule of ozone** consists of three oxygen atoms bonded together.

1-Ultraviolet radiation (UV) splits the bond in the molecule of O_2 giving two free oxygen atoms (2O).

$$O_2 + UV \longrightarrow 2O$$

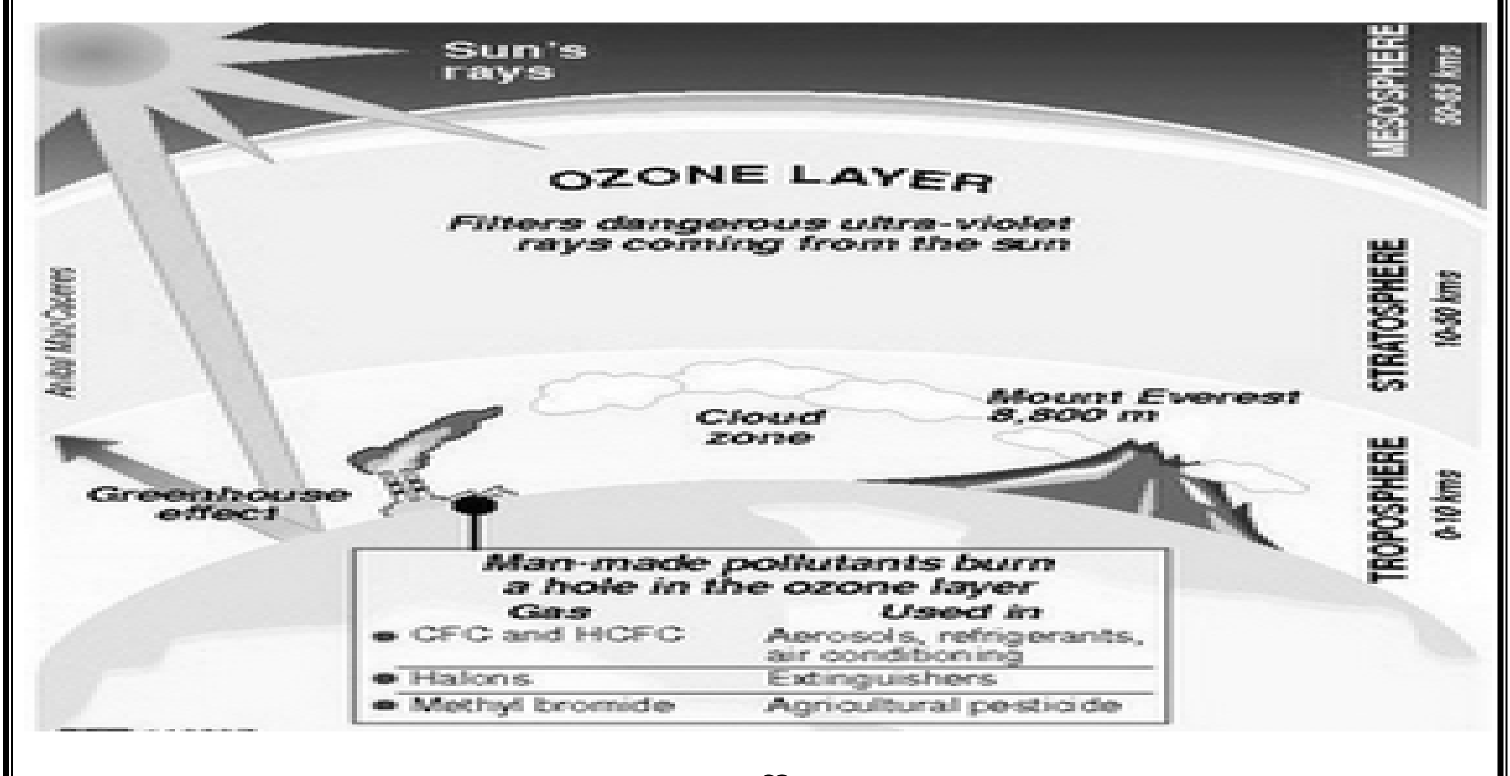
2-An Oxygen atom joins an oxygen molecule forming an ozone molecule O_3

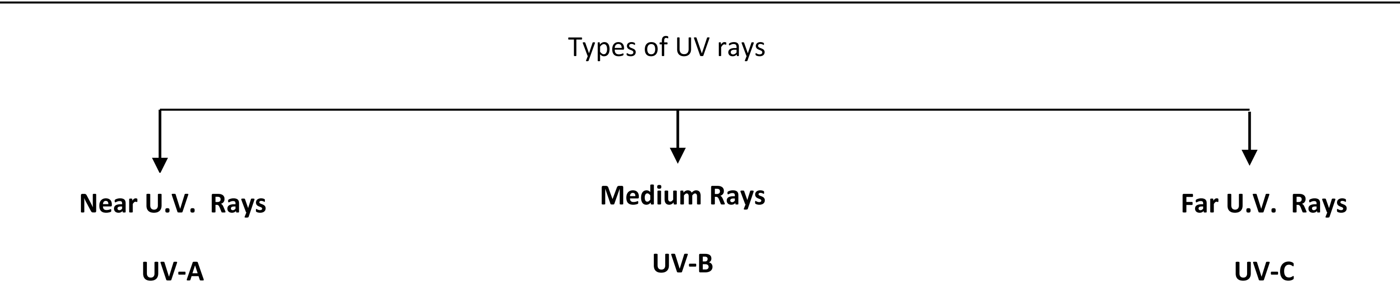
$$O + O_2 \longrightarrow O_3$$

The ozone layer lies in the lower part of stratosphere layer which contains suitable amount of oxygen gas. This layer is 20 **km thick.**

2. Importance of the Ozone layer

The ozone layer **protects & shields the planet** against harmful ultraviolet radiations.





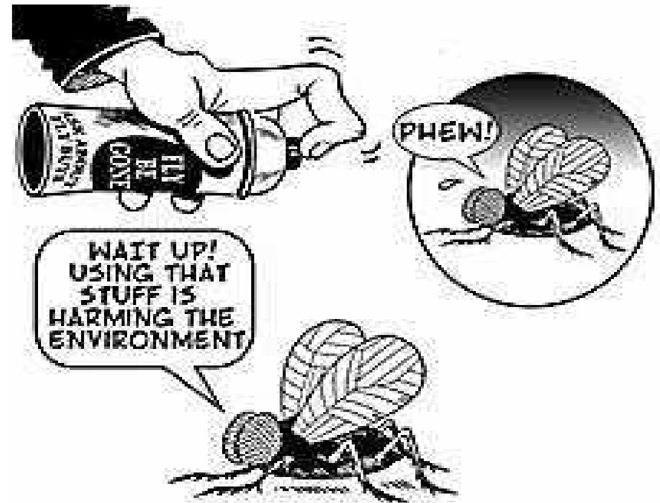
The useful UV – A penetrates the ozone & reaches the earth. Ozone absorbs most of the UV- B & C harmful radiation.

3. The harms of medium & far ultraviolet rays

Living organisms	Harmful effects
Human	1. Skin cancer. 2. Cataract (a disease that affects vision). 3.Reduced immunity
Amphibians	1.The eggs are damaged 2.the rate of reproduction is reduced.
Marine organisms	Death of tiny organisms which are food of fish.
Plants which live on land	Photosynthesis process is reduced & therefore less food is available for plant eating animals.

4. Erosion of Ozone layer is the thinning or decay of parts of Ozone layer.

- Scientists noticed the decay in the ozone above the **South Pole.**
- Erosion of Ozone layer increases in September every year because all pollutants form Black clouds then they're carried by the wind above the South Pole. These pollutants Decay the ozone.



5.Pollutants of ozone layer

1-Chlorofluorocarbon compounds (CFC) known as **Freon are gases** used as:

a. **Cooling** substance used in **air conditioning & fridges.**

b. **Propellant** substance used in **aerosols**

c. **Inflating** substance used in making **foam** packing.

d. **Solvent** substance used for **cleaning electric circuits slides**.

2-Methyl bromide gas :

Used as **insecticide** to preserve stored agriculture crops.

3-Halons :

Used in **fire extinguishers.**

4-Nitrogen oxides :

Produced from burning of fuel of **ultrasonic planes**



6.The effect of chlorofluorocarbons (CFC) compounds on ozone Layer:

1-CFC compounds erode ozone layer in **3 steps:**

$$CFCl_3 \xrightarrow{UV} CFCl_2 + Cl$$

chlorofluorocarbon — **active chlorine atom**

2-Active chlorine atoms (Cl) react with ozone molecules (O_3) forming chlorine monoxide (ClO).

$$Cl + O_3 \longrightarrow O_2 + ClO$$

active chlorine atom — **Ozone molecule** — **Chlorine monoxide**

3-Chlorine monoxide (ClO) reacts with another ozone molecule, releasing an active chlorine atom destroying more ozone molecules.

$$ClO + O_3 \longrightarrow 2O_2 + Cl$$

Chlorine monoxide — **Ozone molecule** — **active chlorine atom**

7.Protecting the ozone layer:

Leaders of the world recommended rules to protect the ozone. **The protocol called Montreal Protocol, recommended the reduction of chlorofluorocarbon compounds & the use of safer alternatives.**

8.Global warming



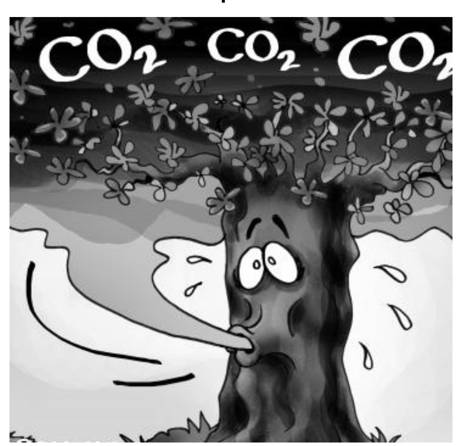
- The energy of the sun is transmitted through space in the form of light &short wave radiation. This radiation isn't absorbed by the air.
- The surface of the earth absorbs short-wave radiations & emits long wave heat radiation towards the atmosphere. CO_2 & H_2O in the atmosphere trap the heat emitted by the earth & keep the air warm enough for living organisms to survive.
- CO_2 & H_2O act like the green house which absorbs warmth & keeps plants warm within. The effect of CO_2 & H_2O in trapping heat & keeping the atmosphere warm is called **the greenhouse effect.**

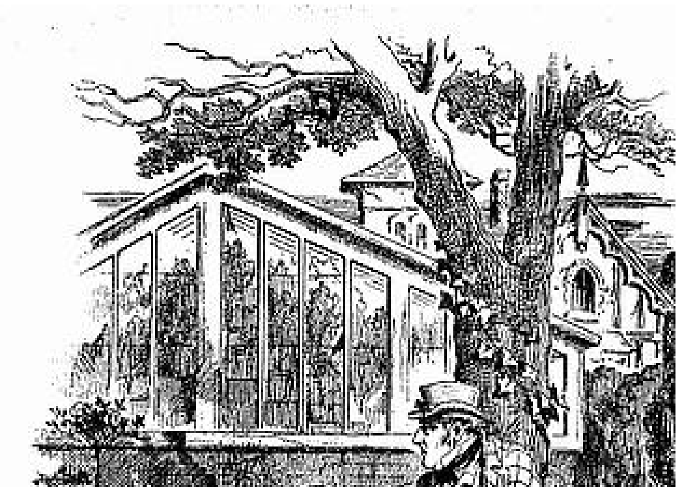
Some energy is radiated back into space by the earth in the form of infrared waves

Some of this outgoing infrared radiation is trapped by the earth's atmosphere and warms it

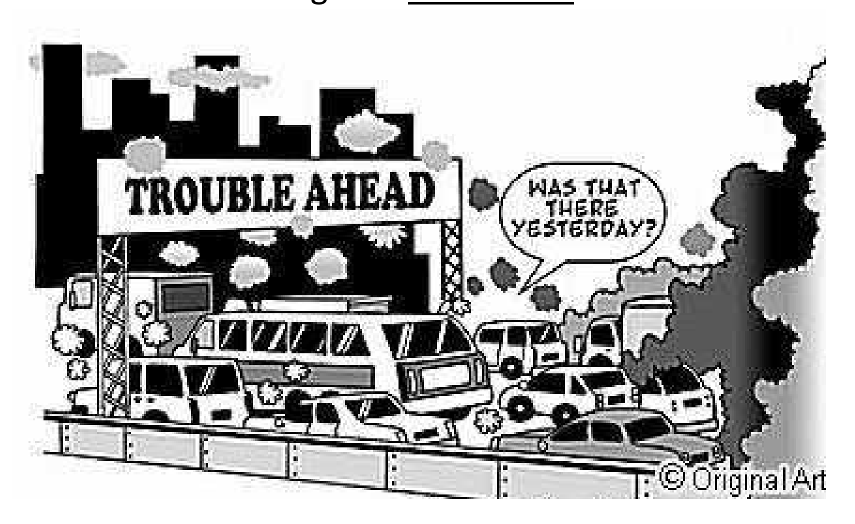
Most of this radiation is absorbed by the Earth and warms it

- In the last century, humans made different types of machines which burn fossil fuels to work.
- The burning of fuel releases CO_2 & H_2O in the atmosphere.
- The percentage of CO_2 & H_2O in the atmosphere increased nowadays because of the burnt fuel & forest fires.
- Trees absorb CO_2 during photosynthesis therefore cutting trees to use their wood increased CO_2 in the atmosphere.





- The accumulation of CO_2 & H_2O increased the temperature of the atmosphere above normal & this increase is called global warming.
- Global warming caused polar caps to melt; the excess water flooded the coasts. Polar bears & seals are in danger of **extinction.**



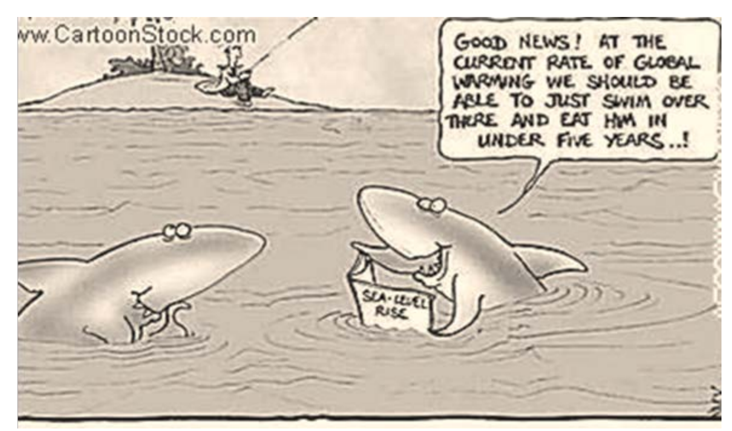


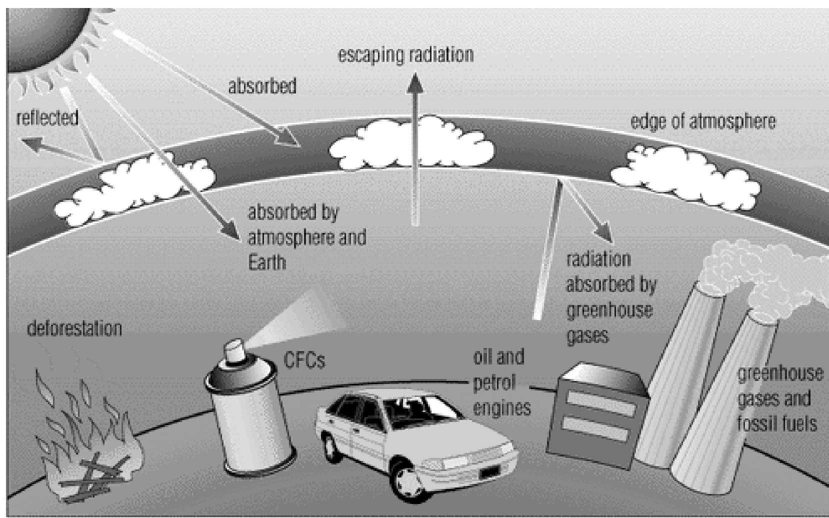
- Global warming is responsible for severe weather phenomena such as hurricanes, drought & floods.
- Kyoto protocol contains recommendations towards reduction of fuel burning & green house gas emission to help reduce global warming. The main greenhouse gases are

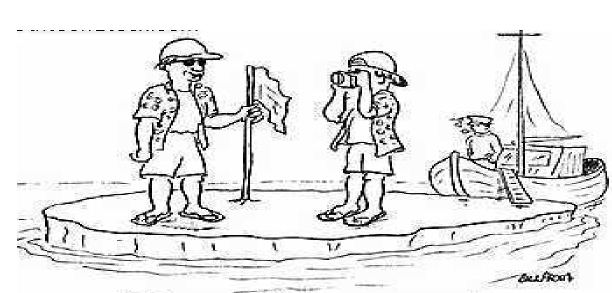
Carbon dioxide CO_2 - Chlorofluorocarbon – methane CH_4 - Water vapour H_2O - Nitrous oxide N_2O



"At least there's not so much congestion."

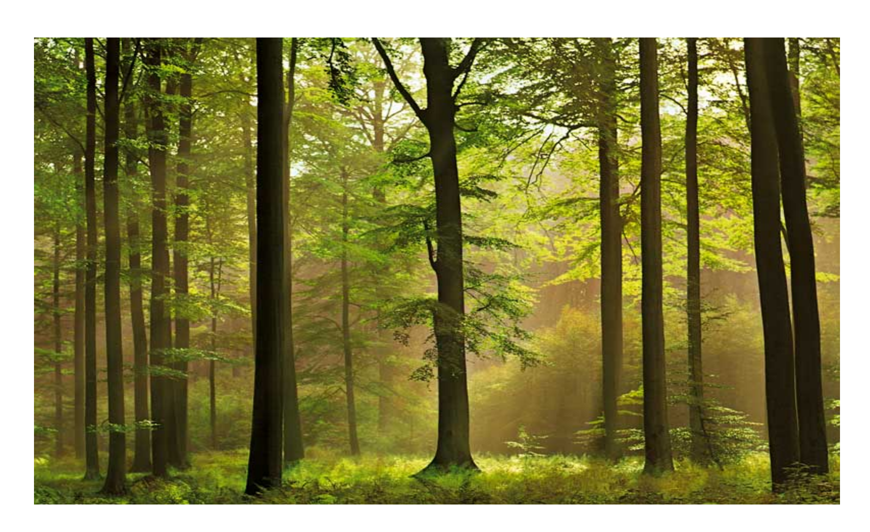





"Polar expeditions are easy now! Thanks to global warming."



Unit 3: Fossils and Protecting Species from Extinction



Lesson 1:

Fossils





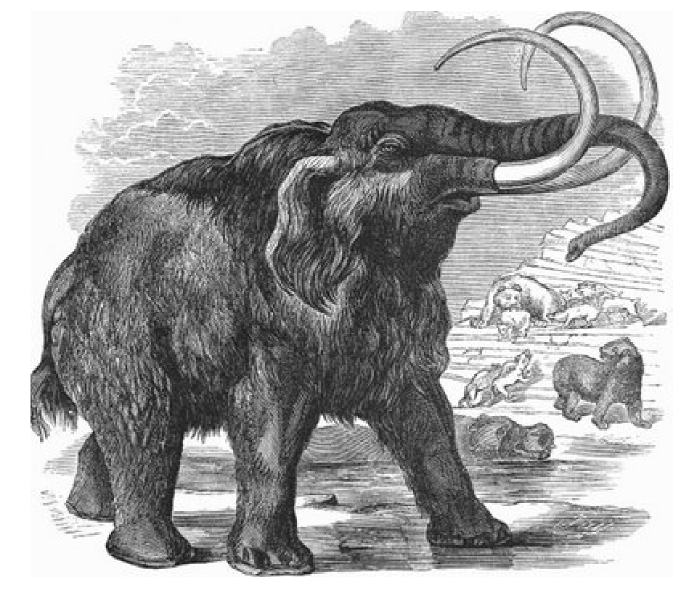


Lesson 2:

Extinction

Lesson 1 :Fossils

1-What are fossils?



- How did scientist learn about dinosaurs which lived millions of years ago?
- Scientists study fossils.
- **A fossil is the trace or remains of an organism that lived long ago preserved in sedimentary rock**
- Fossils made from parts of an organism's body are called body fossils. Other fossils are signs of an organism, such as footprints.

2-Fossils in rocks:

Organisms die & become buried in sediments, which preserve the organism. The sediments harden forming sedimentary rocks.

Dinosaur's foot print

Examples of body fossil:

a-Mammoth fossil :

- Mammoth is an elephant- like animal which lived in ice age . A mammoth was buried by an avalanche. The snow preserved the mammoth body from decomposition.
- Although mammoth are now extinct, scientists found frozen remains of mammoths preserved in blocks of ice.

b-Amber fossil:

Sometimes, organisms such as insects are caught in sticky tree sap. The sap hardens around the insect forming a fossil. The hardened tree sap is called amber.



3-Molds & casts

A **mold** is an impression left where a plant or an animal was buried.

A **cast** is formed when sediment fills the mold (or sea shell) then solidifies & becomes rock.


Trilobite fossil




Ammonite cast & mold

4-Petrified fossils:

Organisms can become fossils by petrifaction. During petrifaction, minerals replace the organism tissues.

Examples:

Petrified dinosaur's tooth & eggs - petrified wood .



5- Importance of fossils:

a - **Fossils can show scientists**:

- What kind of organisms lived in the past.
- How the environment has changed with time.
- How organisms have changed with time.

b- Index fossils are fossils of organisms that lived during a short period of time, therefore they're found in rocks of certain age.

Trilobite is an index fossil, because this organism lived 400 million years ago,

This indicates that the rocks surrounding it are 400 million years ago.

c- **A history of environmental & climate changes.**

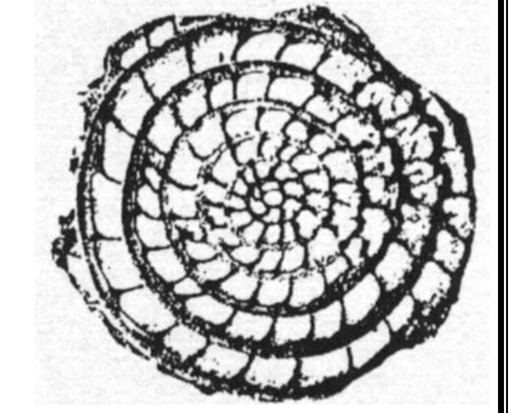
Examples:

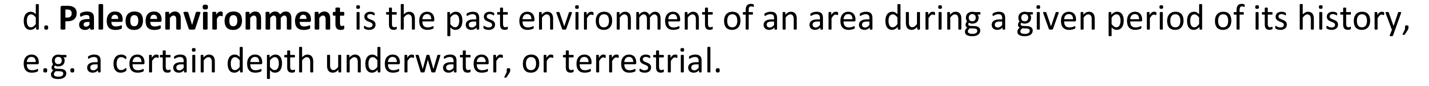
a. Nummulite fossils found in Mokattm Mountain indicate that it was a sea 35 million years ago.

b. Fern fossils indicate the region's climate used to be hot & rainy.

c. Coral fossils indicate that their environment used to be warm shallow sea.

Nummulite fossil





d. **Paleoenvironment** is the past environment of an area during a given period of its history, e.g. a certain depth underwater, or terrestrial.



6- A history of changing organisms:

By comparing fossils, scientists were able to understand how life changed on earth. They concluded the following.

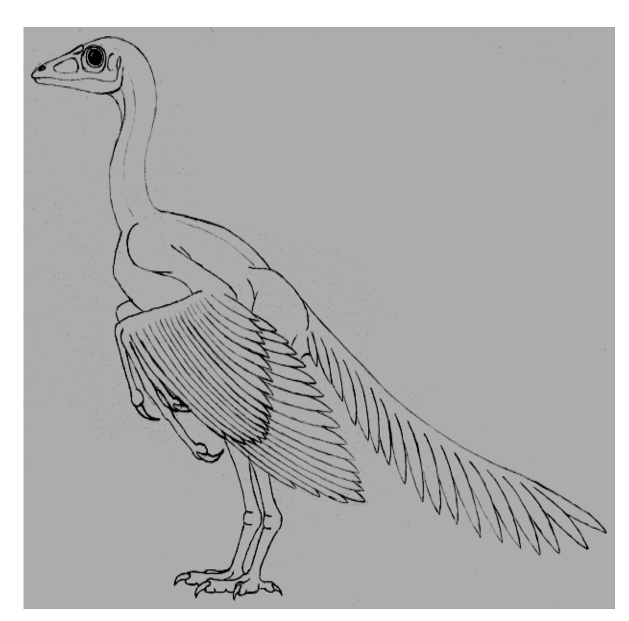
1-Algae lived first. They were followed by mosses & ferns.

2- Gymnosperms were followed by angiosperm.

3- Invertebrates such as corals & mollusks may have lived before vertebrates.

4- Fish were the first vertebrates.
5- Amphibians reptiles, birds & mammals then appeared on earth.





archaeopteryx

7-Petroleum oil exploration:

Petroleum oil was formed from remains of organisms that lived long ago.

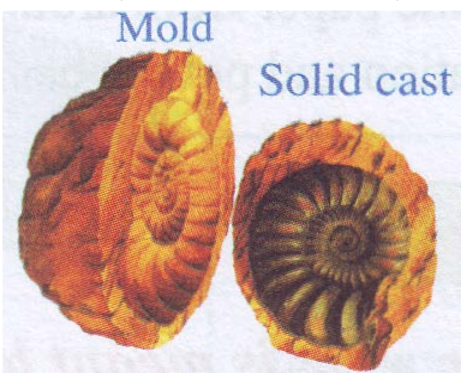
To identify the rocks which contain petroleum, scientists take samples of rocks & examine them. The presence of certain organism indicates the presence of oil & the possibility of digging a well in this region.

8-Some important definitions:

Fossil: is the trace or remains of an organism that lived long ago & was preserved in sedimentary rock.

Cast: a type of fossil that forms when sediments fill in the cavity filled by a decomposed organism.

Mold: a mark or cavity made in a rock by the shell or other body.



Ammonite fossil

Trace fossil: a mark formed in the rock by the movement of an animal on soft sediment.



Footprint



Fern fossil



Trilobite fossil



Enriching information for reading

Abu Roash a geological & historic site

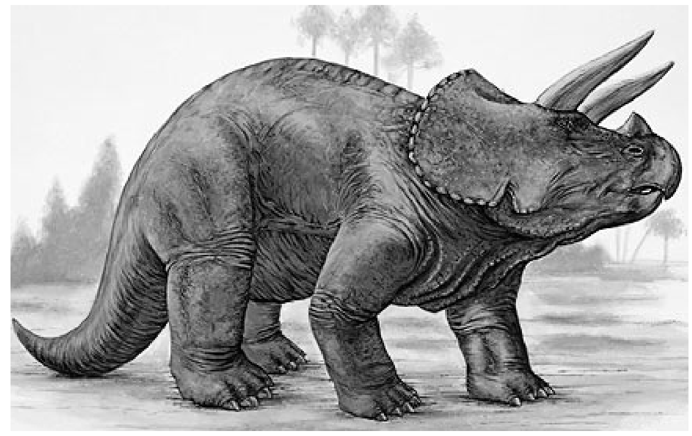
- Location: 8 km to the North of Giza
- The site of a ruined pyramid.
- **Geology of Abu Rawash**: The sedimentary rocks in Abu Rawash area belong are from Late Cretaceous period (145 – 65 million years ago) & help geologists to study the paeloenvironment.



The ruined pyramid atop the plateau of Abu Rawash

Lesson 2: Extinction

- **<u>Arwa ram</u>** is an Egyptian wild animal which is disappearing from the wildlife. Without preservation of the remaining individuals they will become **extinct**.
- **<u>Extinction is the continuous decrease in the number of individuals of a species of living organisms. Without compensating for dead organisms.</u>**
- **<u>The moment of extinction</u>** is the date of death of the last individual of that species.
- **<u>Fossils are traces and remains of extinct organisms preserved in sedimentary rocks.</u>**
- Fossils are studied to learn about species that don't exist anymore. The fossil record are the rocks that contain fossils, these show:



1. The terrestrial life appeared 570 million years ago. Different **<u>species flourished</u>** then their numbers decreased rapidly then they became **<u>extinct</u>**.
2. About **<u>98% of organisms</u>** appeared and became **<u>extinct</u>** before Allah created man . One of the extinct species is **<u>dinosaurs.</u>**
3. Fossils of some fish, reptiles and birds that lived in the past show that these animals are different from their counterparts now.

Factors causing extinction of species

Extinction in the past was caused by

a-**The impact of celestial bodies called meteorites** with the earth.

b-A long **glacial (ice) age.**

c-**Poisonous gases** emitted from **volcanoes.**

Recently , extinction is caused when humans interfere with the balanced environment by:

1-Destroying natural habitats

2-Overhunting

3-Environmental pollution

4-Climate changes and natural disasters.



1- Destroying natural habitat :

1-**One third of terrestrial animals live in tropical forests** .A tree shelters about **300 species**

Overcutting of forests ⟶ 68 species of trees disappear daily ⟶ loss of the habitat of many species

2-Overhunting

• No laws to regulate wild animal hunting. • Better & bigger weapons. • High prices of animals' skin and furs.	⟶	Overhunting	⟶	Extinction of hundreds of reptiles and mammals species

3-Pollution by:

a. Acid rains which kill trees in forests.

b. Insecticides kill insects which are the food of other organisms so they die of hunger.

c. Oil leaks from oil tankers during navigation kill marine organisms.

4-Climate changes & natural disasters such as : drought , tornadoes , floods , torrents , earthquakes , volcanoes & high sea waves called Tsunami.







Examples of extinct species in old times: Dinosaurs & mammoth

Examples of extinct species in recent times:

Extinct species	Cause of extinction
1-Dodo bird which lived in India	Overhunting because it doesn't fly
2-Quagga (an animal between horse & zebra)	Overhunting
3-Passenger pigeon	Overhunting The female only lays one egg. Cutting oak tree where it builds its nest.
4-Tasmanian cat (an animal with mixed characters of kangaroo, tiger, wolf & dog)	Farmers hunted it to get rid of it since it preyed on chicken.
5-Golden frog	

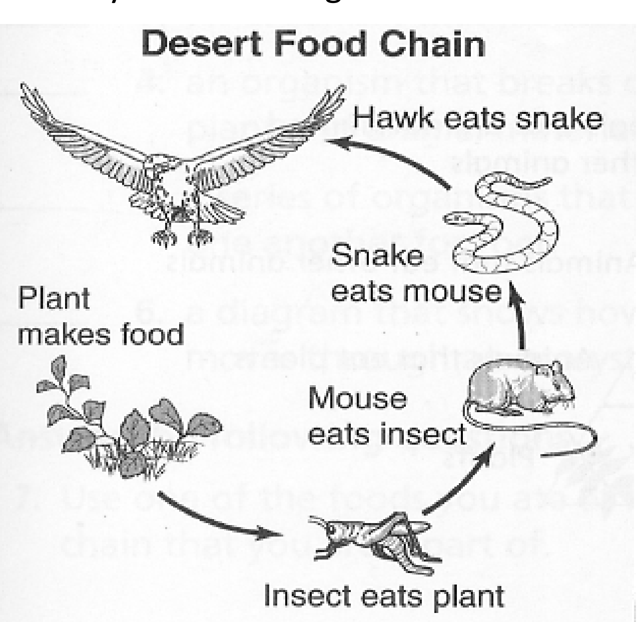
Endangered species

- The international union for conservation of nature (IUCN) works to protect endangered species.
- IUCN issues a red list of endangered species & the danger level they suffer according to the rate of decline or increase of organisms in its environment.
- Critically endangered species are labeled **CR**
- Endangered species are labeled **EN**
- Vulnerable species are labeled **VU**

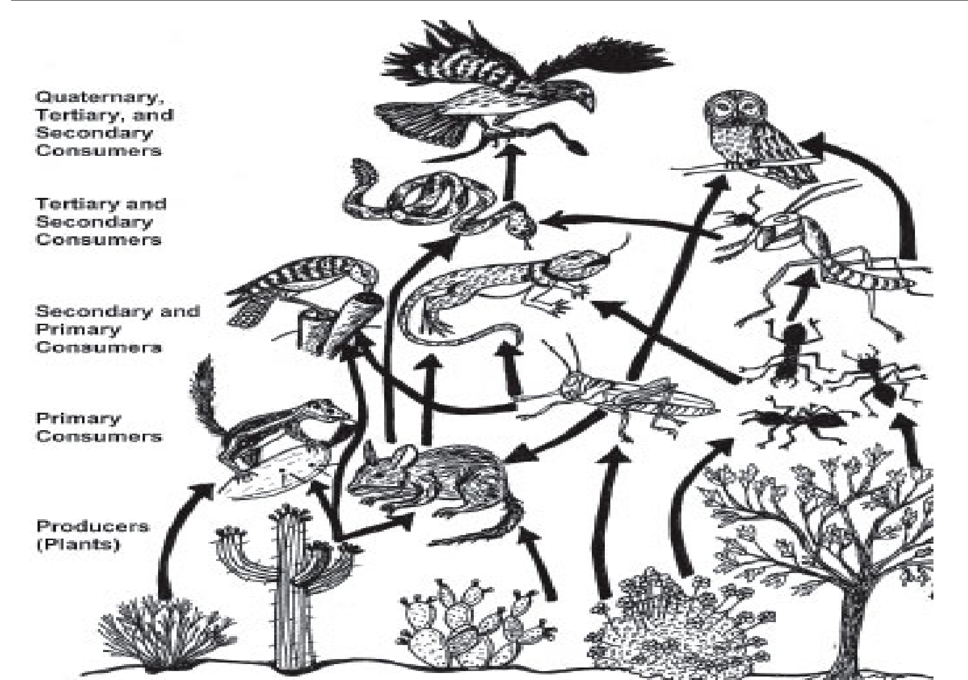
Endangered species	Cause of endanger
1-Panda bear	Low rate of reproduction + bamboo shoots are its only food take 100 year to blossom
2-Rhinoceros	Overhunting for its horn + Cutting forest trees to cultivate the land.
3-Bald eagle	It feeds on fish polluted by poisons dumped in water resources.
4-Ibis bird	High dam was built were it lived.
5-Papyrus plant	The swamps where it grows were dried.

The ecosystem **is the living organisms & non-living components of a certain environment.**

- The desert is an ecosystem, the sea is another ecosystem & the forest is a third one.
- **The energy of the sun is converted into chemical energy stored in the food produced by plants.**
- Animals eat food to get the energy stored in it.
- The feeding relation between organisms is expressed as a food chain starts with the plant then the animal which eats plant then the animal which feeds on the herb eating animal.
- **The food chain is a relation between living organisms which shows how energy is transferred from an organism to another through food.**
- If an animal becomes extinct, other animals which feed on it are endangered by extinction as well. Therefore the food chain is disturbed.
- In a food chain that consists of plants then locust the mouse then snake. The death of mice causes the death of snakes from hunger, while locust increases.
- The balance in the ecosystem is disturbed & the ecosystem is damaged.



Points of comparison	*A simple ecosystem*	*A complicated ecosystem*
An example	the desert	tropical forest
Response to death of a species in the ecosystem	Contains limited number of organisms & therefore is disturbed hugely by the extinction of one of its animals.	has a large number of organisms & therefore isn't affected by the death of a species largely



Desert ecosystem



Tropical forest ecosystem

Protecting organisms from extinction

1. Put rules to regulate hunting.
2. Spread the message of preservation through the media
3. Reproduction of endangered species in protected areas.
4. Gene banks contain samples of endangered organisms to help study them.

5-Natural protectorates are areas to keep endangered animals without hunting.



Examples of protectorates(national parks):

Bluestone protectorate in U.S.A. protects grey bears.

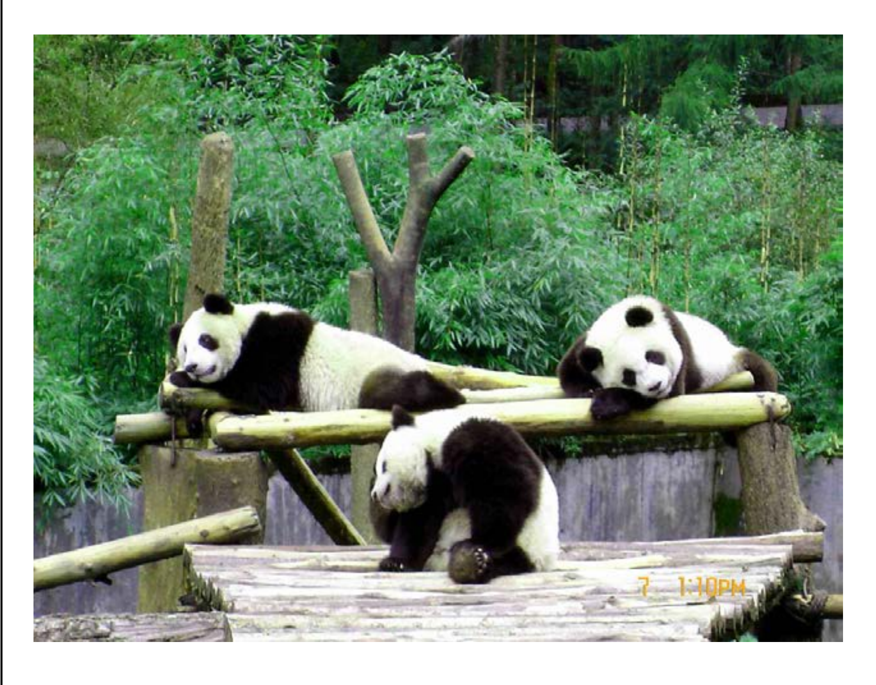
Panda protectorate in China

Ras Mohamed in South Sinai where corals

& fish are protected.



Sinai Ras Mohamed national park



Pandas living in a national park in China